Home Theater Series

NANOAVR DL

8-CHANNEL HDMI AUDIO PROCESSOR WITH DIRAC LIVE® TECHNOLOGY

User Manual

Revision history

Revision	Description	Date
1.0	Initial public release	4 December 2014
1.1	Custom configuration, AVR configuration, smartphone app, channel mode	19 May 2015
1.2	Updated firmware update procedure	20 May 2015

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IMPORTANT INFORMATION

Please read the following information before use. In case of any questions, please contact miniDSP via the support portal at minidsp.desk.com.

SYSTEM REQUIREMENTS

To configure your NanoAVR DL HDMI audio processor, you will require a Windows PC with the following minimum specification:

- Intel Pentium III or later, AMD Athlon XP or later
- 2 Gigabytes (GB) of RAM or higher
- Keyboard and mouse or compatible pointing device
- Microsoft® Windows® Vista® SP1/Win7/Win8
- Microsoft® .NET framework v3.5 or later
- Two free USB 2.0 ports

DISCLAIMER/WARNING

miniDSP cannot be held responsible for any damage that may result from the improper use or incorrect configuration of this product. Please read this manual carefully to ensure that you fully understand how to operate and use this product, as incorrect use or use beyond the parameters and ways recommended in this manual have the potential to cause damage to your audio system.

Please also note that many of the questions we receive at the technical support department are already answered in this User Manual and in the online application notes on the miniDSP.com website. So please take the time to carefully read this user manual and the online technical documentation. And if an issue arises with your unit, please read through the Troubleshooting section first. Thank you for your understanding!

WARRANTY TERMS

miniDSP Ltd warrants this product to be free from defects in materials and workmanship for a period of one year from the invoice date. Our warranty does not cover failure of the product due to incorrect connection or installation, improper or undocumented use, unauthorized servicing, modification or alteration of the unit in any way, or any usage outside of that recommended in this manual. If in doubt, contact miniDSP prior to use.

FCC CLASS B STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

Warning: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Notice: Shielded interface cable must be used in order to comply with emission limits.

Notice: Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CE Mark Statement

The nanoAVR DL has passed the test performed according to European Standard EN 55022 Class B.

What's Included

- One **nanoAVR DL** HDMI audio processor
- One universal 5 VDC power supply with interchangeable power pins
- One USB cable for computer connectivity (1.5m)
- One flat HDMI v1.4 cable (1.5m)
- One full license for **Dirac Live Calibration Tool for miniDSP**
- Printed Quick-start Guide

Note: your nanoAVR DL purchase does not include the required UMIK-1 USB measurement microphone. Please add a UMIK-1 to your order if you do not already have one.

A Note on this Manual

This User Manual is designed for reading in both print and on the computer. If printing the manual, please print double-sided. The embedded page size is 8½" x 11". Printing on A4 paper will result in a slightly reduced size.

For reading on the computer, we have included hyperlinked cross-references throughout the manual. In addition, a table of contents is embedded in the PDF file, which will make navigation much easier:

- In Adobe Reader on Windows, click on the "bookmarks" icon at the left. The table of contents will appear on the left and can be unfolded at each level by clicking on the "+" icons.
- In Preview on the Mac, click on the **View** menu and select **Table of Contents**. The table of contents will appear on the left and can be unfolded at each level by clicking on the triangle icons.

1 Product Overview

Thank you for purchasing a *nanoAVR DL* HDMI audio processor powered by Dirac Live®, the world's premier room correction solution. We are delighted to offer you this software and hardware combination, the fruit of extensive research and development and years of experience in sound system tuning.

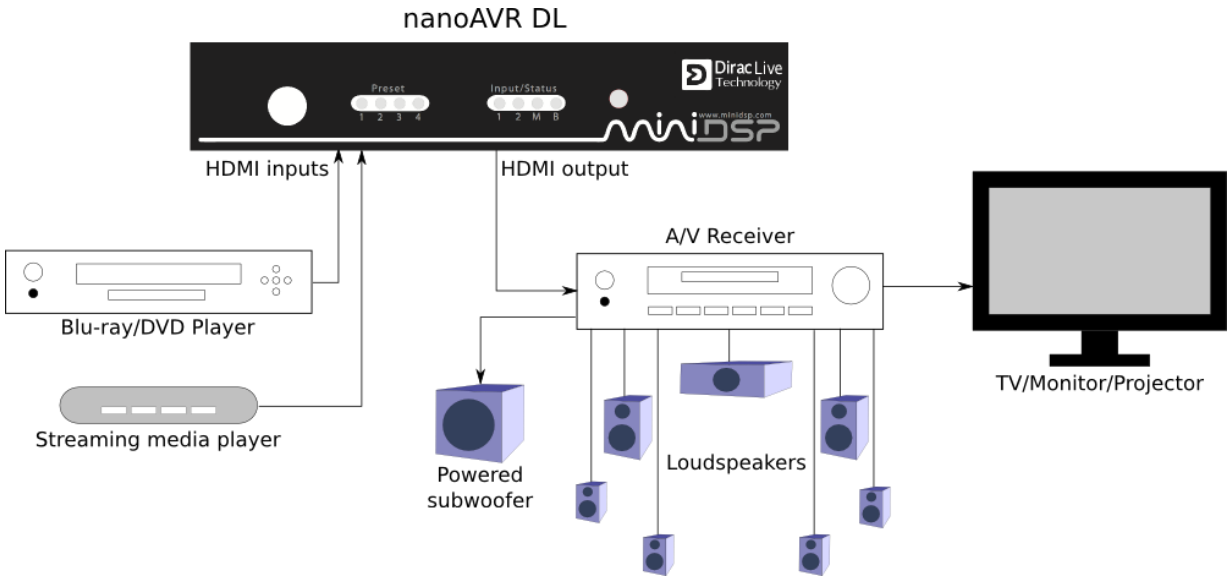
The *nanoAVR DL* is a digital audio signal processor (DSP) running the Dirac Live® room correction algorithm. The onboard floating-point SHARC processor provides time and frequency correction of eight HDMI (v1.4a) audio channels received in linear PCM (LPCM) format. Two HDMI sources can be connected, and selected from the front panel, by an infrared remote control (not included), or a smartphone control app. Video from the selected input is switched directly to the output with no processing applied to the video signal.

Typically deployed in 5.1 or 7.1 home theater systems, the *nanoAVR DL* processor will:

- Improve imaging and immersion
- Improve clarity of music and dialog
- Produce a tighter bass
- Reduce listening fatigue
- Remove resonances and room modes
- Reduce early reflections

1.1 Typical System Configuration

In its most typical application, the nanoAVR DL connects between an HDMI source such as a Blu-ray player and an A/V receiver. The nanoAVR DL implements the world-leading Dirac Live® room correction algorithm on all audio channels, while passing video through from the selected HDMI input to the HDMI output. The second HDMI input allows connection of another device such as a computer/HTPC or media streamer.



Computer connectivity is used to perform acoustic measurements and generate digital room correction filters for Dirac Live®. Up to four sets of correction filters can be stored on the NanoAVR DL processor and recalled from the front panel, via an infrared remote, or with the miniDSP smartphone app. Once the processor is fully configured, the computer is no longer needed.

1.2 How Dirac Live® works

The miniDSP nanoAVR DL HDMI audio processor includes Dirac Live®, a premium mixed-phase room correction technology. This technology is used not only in home stereo and home theater systems but also in cinemas, recording studios, and luxury cars.

As with any room correction system, Dirac Live® corrects the system's *magnitude response* (often referred to imprecisely as "frequency response"). In contrast to fully automated systems, Dirac Live® corrects the magnitude response towards a user-adjustable *target response*. The target response takes account of the natural frequency range of the loudspeaker system and the normal effects of loudspeaker dispersion on the measured *in-room* magnitude response.

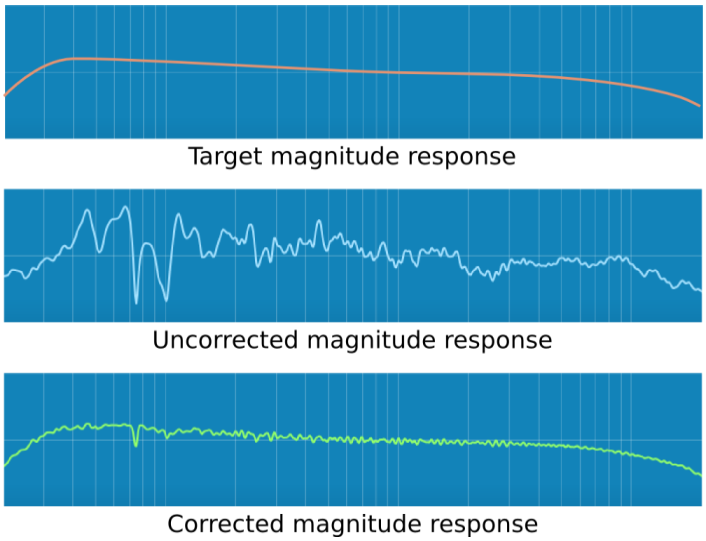


Illustration of Dirac Live® magnitude response correction

In addition, Dirac Live® corrects the system's *impulse response*, which reflects how the system responds to a sharp transient such as a drumbeat. Reflections, diffraction, resonances, misaligned drivers, and so on, all combine to smear out the transient. An ideal loudspeaker has none of these, so correcting the impulse response makes the speaker in the room behave much more like that ideal loudspeaker. The impulse response is a critical factor for accurate sound-staging, clarity and bass reproduction. Dirac Live® employs a sophisticated analysis algorithm to make the optimal correction across the *whole* listening area, not just at a single point.

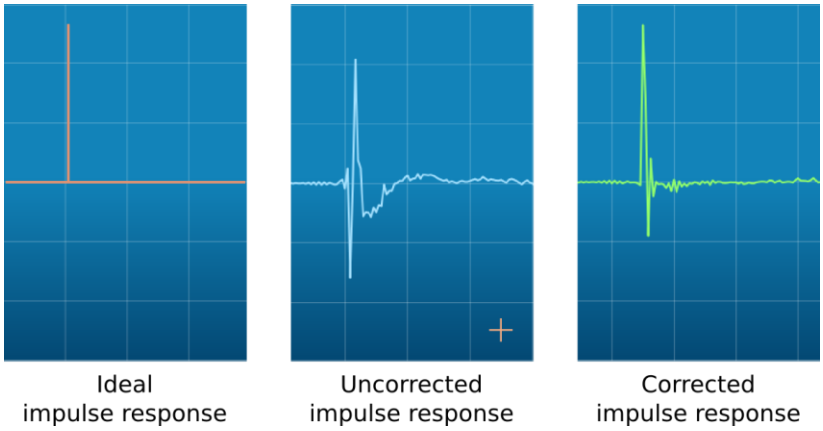


Illustration of Dirac Live® impulse response correction

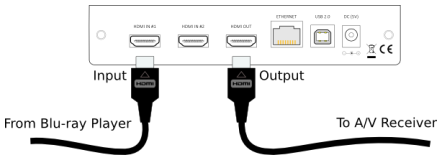
Dirac Live® accomplishes this using *mixed-phase filters* – filters that match a desired magnitude response *and* generate a customized impulse response. This contrasts with the *minimum-phase* and *linear-phase* filters that are commonly used in audio applications. While minimum-phase and linear-phase filters are relatively easy to design, they are tightly constrained in their impulse response characteristics – neither can make a desired change to the magnitude response independently of controlling the impulse response. In some cases, they may even make things worse.

Mixed-phase filters are more difficult to design, but the audible performance of Dirac Live® is due to its success in using mixed-phase filters to make the system response across the *whole* listening area more closely resemble that of an ideal speaker. The energy from the direct wave and from early reflections is optimally combined to arrive as a single wavefront to the listener. Late reflections are left largely untouched, being corrected only for their spectral coloration, as they contribute to a larger, more enveloping soundstage.

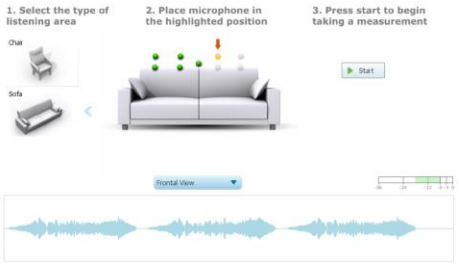
1.3 CONFIGURATION OVERVIEW

The steps for configuring the nanoAVR DL HDMI audio processor with Dirac Live® to optimize your home theater system is summarized as follows:

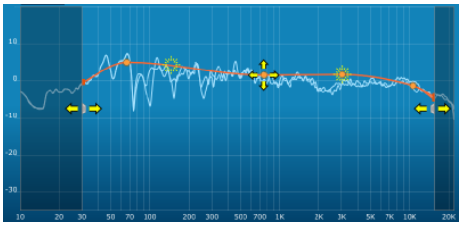
1. Connect the nanoAVR DL audio processor into your system and install software. See Section 2, Installation and Setup.



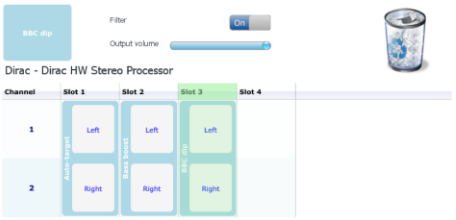
2. Execute a series of acoustic measurements on your computer using the **Dirac Live Calibration Tool For miniDSP** program, to capture the acoustic behavior of your speakers and room. See Section 3, Acoustic Measurement.



3. Generate the digital room correction filters that will be executed by the processor. Up to four filter sets can be downloaded into the processor for easy real-time recall and auditioning. See Section 4, Filter Design.



4. Once the digital room correction filters are designed and downloaded, the computer can be disconnected, as computer connectivity is not required for normal listening and operation. See Section 5, Using the nanoAVR DL audio processor.



2 INSTALLATION AND SETUP

2.1 SOFTWARE INSTALLATION AND LICENSE ACTIVATION

Please read this section carefully prior to installing the software.

2.1.1 Framework installation

Prior to installing the software, download and install the following frameworks. You will need to accept the license agreements in order to successfully complete the installation. If you haven't updated these recently, check that you have the latest versions prior to running the miniDSP install programs.

- Microsoft .NET framework (version 3.5 or later)
- Latest version of Adobe Flash
- Latest version of Adobe Air
- Microsoft Visual C++ 2010 Redistributable Package: for x86 (32-bit operating system) or x64 (64-bit operating system).

2.1.2 Software installation

When you receive notification that your order has shipped, your installation software downloads will be available at the *User Downloads* section of the miniDSP website:

http://www.minidsp.com/userdownloads

Navigate to the **nanoAVR** section and then to **nanoAVR DL Downloads**. There you will find two zip files to download:

nanoAVR DL programmer

This will install the **nanoAVR DL Utility program,** used to configure remote control codes, as well as perform various other maintenance operations on the nanoAVR DL, including the serial number necessary for software license activation.

After downloading, unzip the file and run the **nanoAVR_DL.exe** installer.

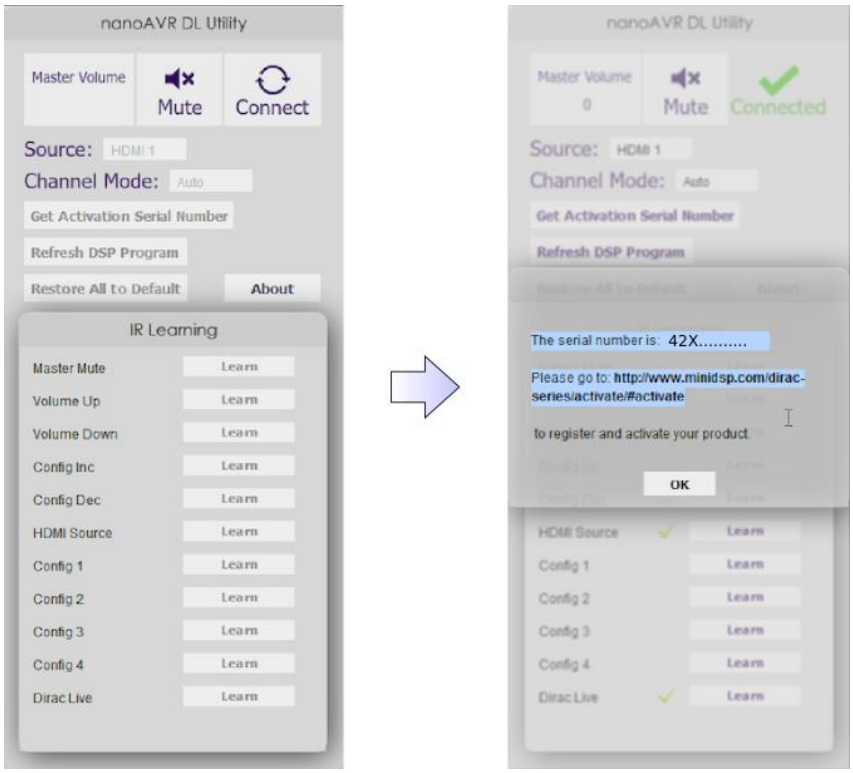
nanoAVR DL Dirac Live Calibration Tools

This will install **Dirac Live Calibration Tool for miniDSP, which** is used to perform measurements, generate correction filters, and load them into the nanoAVR DL.

After downloading, unzip the file and run the **Dirac Live Calibration Tool v1.0.5 Setup.exe** installer (the version number may change).

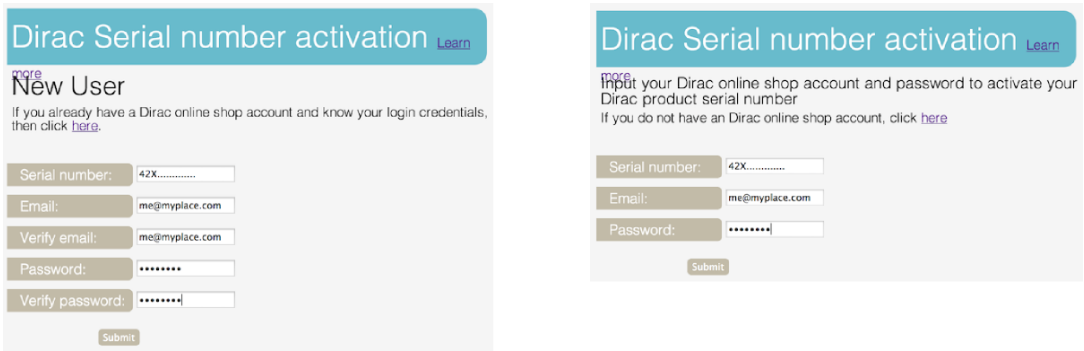
2.1.3 License activation

1. If you are running the **Dirac Live Calibration Tool** already, quit from that program. (You cannot run this program and the **NanoAVR DL Utility** program at the same time.)
2. Start the **NanoAVR DL Utility** program. It will appear as shown on the left below.



3. Connect your nanoAVR DL processor to your computer via USB, then click on the **Connect** button. It will change to a green tick.
4. Click on **Get Activation Serial Number**. The program will get your unique serial number from the connected nanoAVR and display it, as shown on the right above.
5. Using this serial number, activate your license on the miniDSP Dirac Live activation page:

   http://www.minidsp.com/dirac-series/activate/#activate


Dirac Serial number activation
Learn more
New User
If you already have a Dirac online shop account and know your login credentials, then click here.
Serial number:
Email:
Verify email:
Password:
Verify password:
Submit
Dirac Serial number activation
Learn more
Input your Dirac online shop account and password to activate your Dirac product serial number
If you do not have an Dirac online shop account, click here
Serial number:
Email:
Password:
Submit

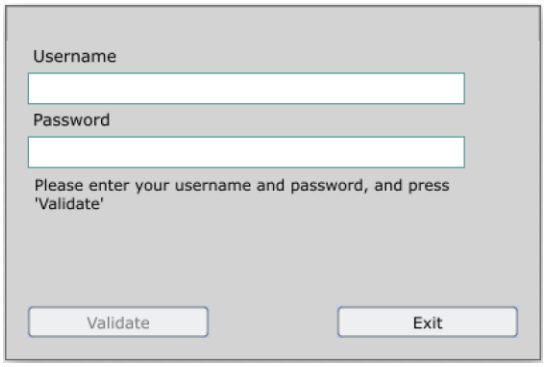
   If you have not purchased a Dirac Live license before, use the **New User** screen on the left. If you have previously activated one or more Dirac Live licenses, use the screen on the right.

Notes:

1. The serial number that must be entered in the activation screen is **not** the serial number printed on the hardware unit. A unique serial number specific to Dirac Live is programmed into the firmware of each unit and can only be accessed with the **nanoAVR DL Utility** program (step 4 above).
2. The email address used during license activation is not related to your user account on miniDSP.com. To activate and validate a Dirac Live license, you must create a separate account on the Dirac server using the form shown at left in step 5 above.
3. If you purchase more than one nanoAVR DL or *Dirac Series* processor, each will need to be activated with its unique serial number. Use the form shown on the right in step 5 above and enter the serial number of each additional processor, and they will in turn be added to your license.

2.1.4 License validation

Quit the **NanoAVR DL Utility** program and start the **Dirac Live Calibration Tool For miniDSP** program. It will ask you to validate your software license. Enter the email address and password that you used when activating your license, and then click on **Validate**:



You will need to be connected to the Internet to validate your license. Any active firewalls will need to have HTTP (normal web traffic) enabled.

The **Username** in the validation screen must be the *email address* that you used in the activation screen in step 5 on page 12. It is **not** your miniDSP website username.

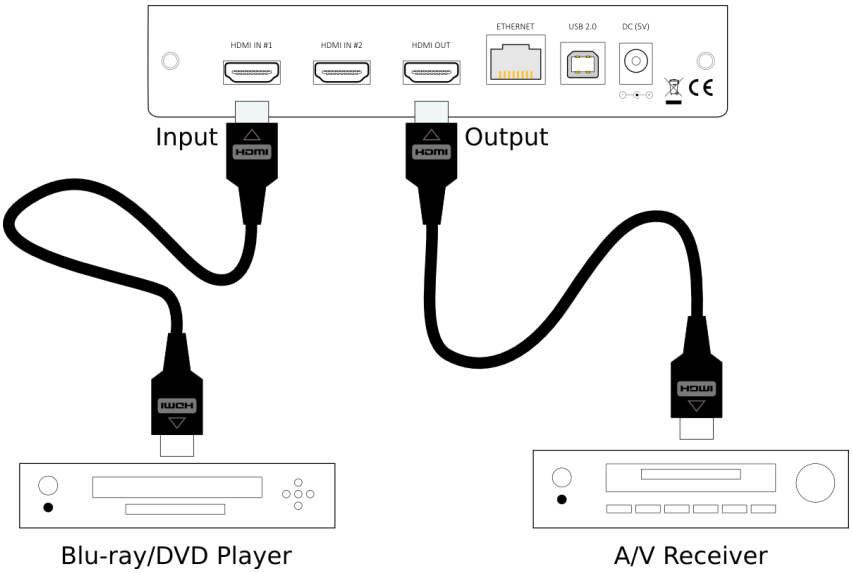
2.2 HARDWARE CONNECTIVITY

All connections to the nanoAVR DL are made on the rear panel.

2.2.1 HDMI input and output

Two HDMI connections are available for input, and one for output. The input connectors can be connected to any HDMI source such as a Blu-ray or DVD player, provided that the source is capable of producing a linear PCM audio signal. Other sources may include media streaming devices and computers with an HDMI port[†].

The HDMI output will need to be connected to an HDMI input on an A/V receiver (AVR) or A/V processor (AVP).



Ensure that your HDMI sources are set to produce linear PCM (also referred to as PCM, L-PCM, or LPCM) on their HDMI outputs. The nanoAVR DL does not decode compressed formats such as Dolby and DTS.

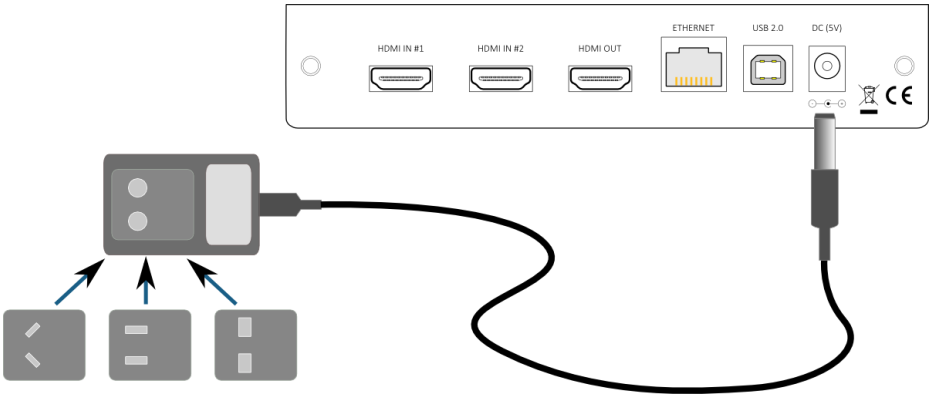
[†] Apple Macs with a Thunderbolt port can be connected to the nanoAVR DL with the use of a Thunderbolt to HDMI adapter cable.

2.2.2 Ethernet

To control the nanoAVR DL using the miniDSP smartphone app, you can connect it to your home network via the Ethernet port. See Smartphone control app on page 38.

2.2.3 DC Power

The supplied 5 VDC power supply includes a set of interchangeable power pins. Fit the correct pins for your country. Connect the DC plug to the 5 VDC power socket.

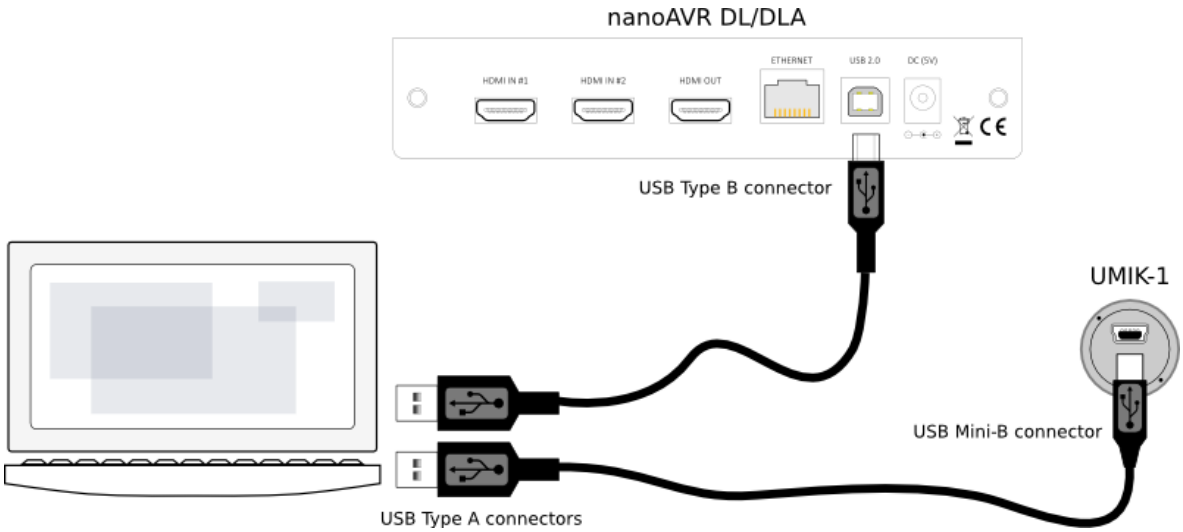


HDMI units communicate with a set of "hand-shaking" signals in order to establish the capabilities of each device. We recommend that for at least the first time the system is powered up, equipment be powered on in this order: TV, AVR, nanoAVR DL, source/player.

2.2.4 USB

To configure the nanoAVR DL using **Dirac Live Calibration Tool for miniDSP**:

- Connect the USB port of the nanoAVR DL to a USB 2.0 port on your computer using the supplied cable .
- Connect a miniDSP UMIK-1 to a second USB port on your computer.



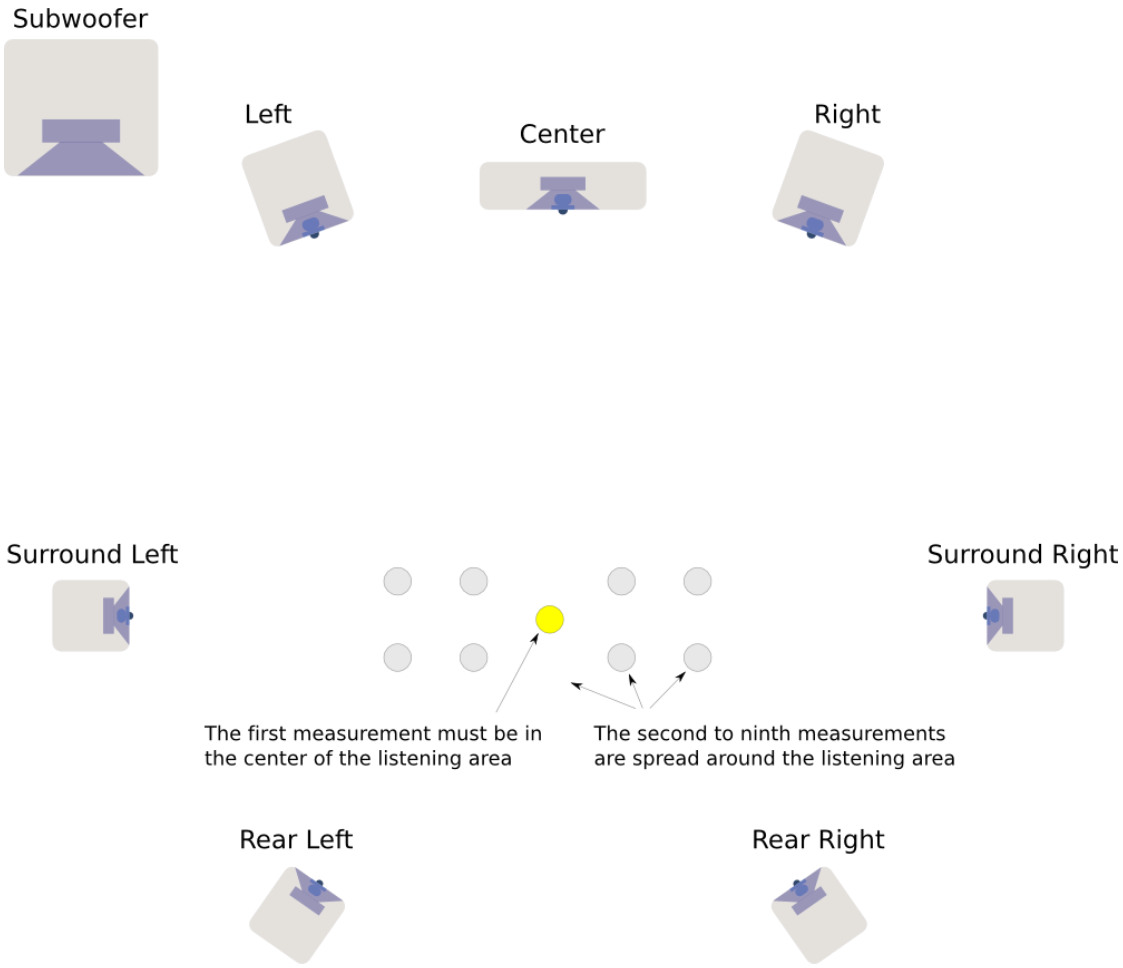
The miniDSP UMIK-1 is the only measurement microphone that can be used with the nanoAVR DL and **Dirac Live Calibration Tool for miniDSP**.

3 ACOUSTIC MEASUREMENT

The **Dirac Live Calibration Tool For miniDSP** uses a set of measurements made in your listening room to gather all the acoustical information about your room and speakers that it needs to calculate the correction filters. The measurements are made using the nanoAVR DL HDMI audio processor and a miniDSP UMIK-1 measurement microphone (must be purchased separately).

3.1 LOUDSPEAKER AND MICROPHONE POSITIONING

Prior to performing acoustic measurements, loudspeaker and subwoofer positioning should be optimized. In particular, the location of the subwoofer within the room will have a large impact on the smoothness of bass response. With Dirac Live®, you have more freedom with loudspeaker and subwoofer placement, but the best result will still be achieved if optimal placement is used together with Dirac Live ®.

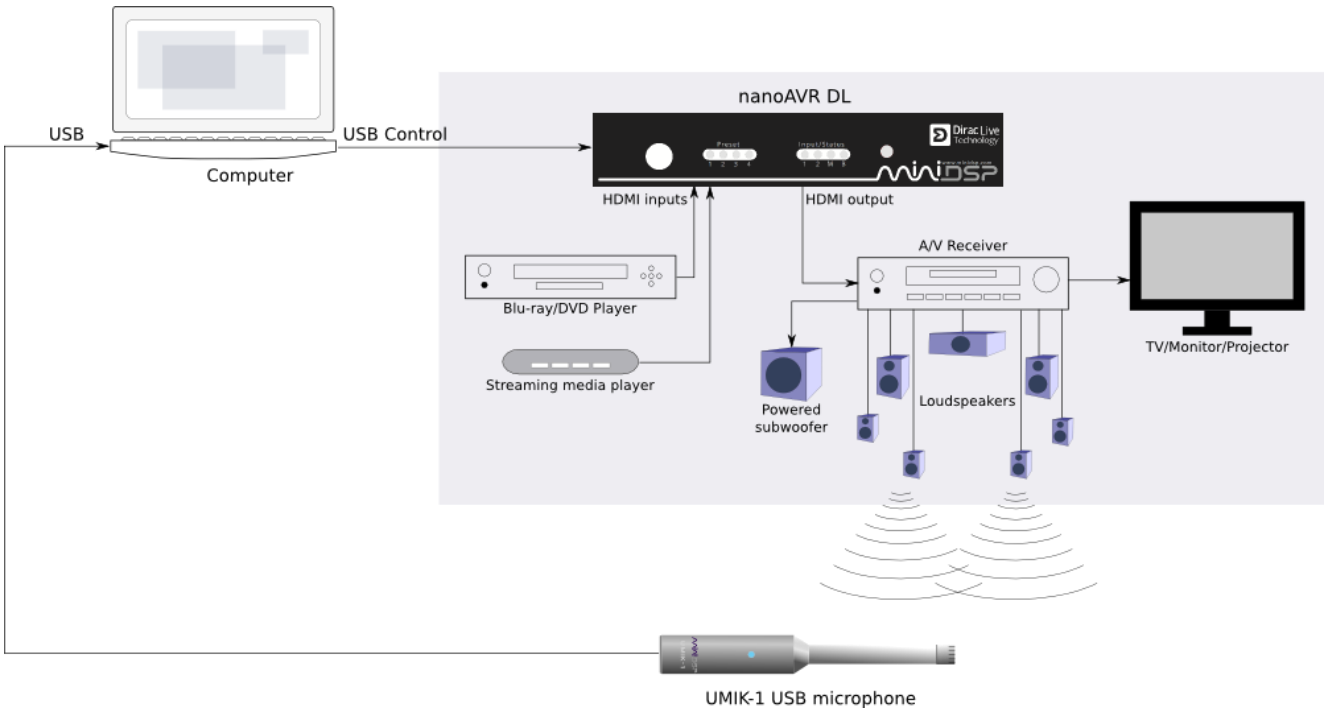


A total of nine measurements are needed, with the microphone located in different positions in the room and pointed vertically (that is, at the floor or ceiling). The first measurement must be taken at the central location of the listening area, as this location sets the levels and delays of each speaker. Eight more measurements are then taken at locations spread around the listening area and at different heights from the floor.

3.2 CONNECTIONS FOR ACOUSTIC MEASUREMENT

The figure below shows a typical connection diagram for performing acoustic measurement. No changes to the existing audio connections are needed. Simply:

1. Connect the supplied USB cable (type A to type B) from the nanoAVR DL to a USB port on the computer.
2. Connect a USB cable (type A to mini type B) from the UMIK-1 to a USB port on the computer.



Place the UMIK-1 microphone into a microphone stand and position the computer and cabling so that there is enough freedom of movement to move the microphone into the needed locations. A small tripod stand is supplied with the UMIK-1, but a larger stand with boom arm can be used if desired. If necessary a USB extension (up to a total USB cable length of 5 meters) can be used. We recommend that the microphone be oriented vertically (pointed at the floor or ceiling) and the "90 degree" calibration file used (see Mic Config tab below).

3.3 A/V RECEIVER CONFIGURATION

The AVR connected to the nanoAVR DL output needs to be set appropriately for best results from Dirac Live. This must be done prior to performing the Dirac Live calibration.

3.3.1 Speaker distance (delay)

Set the speaker distance (or equivalently, delays) in your AVR using the procedure recommended by your AVR manufacturer. While Dirac Live calculates the relative delays between all channels and corrects for any differences, correct delays in the AVR are necessary for bass management to function correctly.

3.3.2 Level trims

Set the level trims in the AVR using the procedure recommended by your AVR manufacturer. While Dirac Live aligns the gain of all channels, correct level settings in the AVR will avoid potential issues with reduced dynamic range and errors in bass management.

In the case of the subwoofer channel, if more output is required from the subwoofer, it preferable to increase the gain control on the subwoofer itself instead of raising the subwoofer trim in the AVR.

3.3.3 Bass management

Set up bass management in the AVR using the procedure recommended by your AVR manufacturer. Advanced users can use an acoustic measurement program such as Room EQ Wizard (REW) together with the UMIK-1 for more precise setting. This ensures that Dirac Live is able to correctly optimize the full frequency range on each HDMI Audio channel.

3.3.4 Room correction

Turn off any room correction in the AVR. Dirac Live performs a full set of sophisticated room correction optimization algorithms, and “adding” additional room correction in the AVR will not improve the result, and quite possibly make it worse.

3.3.5 Channel count/down-mixing

Set the AVR for the number of speakers that you have. In some cases, this will result in the AVR performing "down mixing." Dirac Live will still generate correct equalization for each HDMI source channel.

3.3.6 Other processing

While performing a Dirac Live calibration, all other processing **must** be turned off. In particular, be sure to turn off:

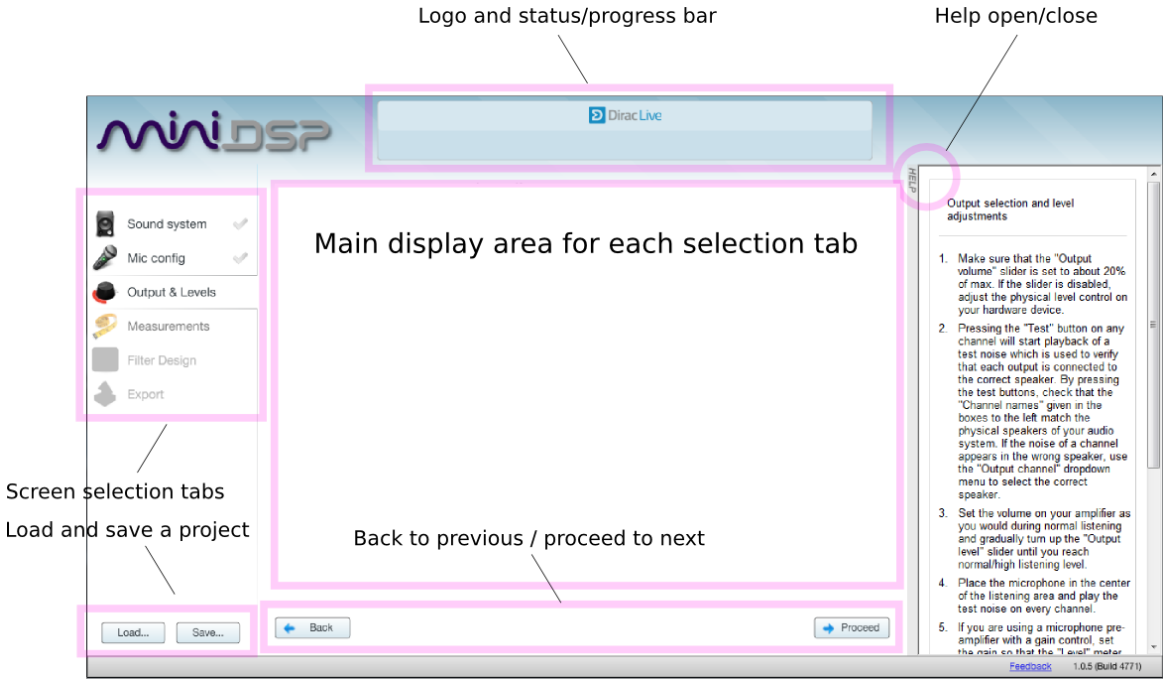
- Up-mixing such as surround-sound simulators
- Surround decoders such as Dolby Pro Logic
- “Effects” such as hall or ambience simulators

After calibration is complete, these effects can be judiciously turned back on, with the understanding that the Dirac Live equalization may no longer be as effective when content is sent "across" channels.

3.4 CONFIGURING FOR MEASUREMENT

Start **Dirac Live Calibration Tool For miniDSP**.

Be sure to quit the **NanoAVR DL Utility** program before starting **Dirac Live Calibration Tool**. Running the two programs at the same time will result in communication conflicts and odd behavior.



Logo and status/progress bar

This area shows a progress bar with current status when the program is performing calculations. If the program seems unresponsive at any time, check the status here.

Screen selection tabs

Each tab selects the information shown in the main display area. These are generally worked through in order, from top to bottom. This section covers the first four tabs; the final two are covered in Filter Design.

Load and save a project

A set of measurements can be saved to a file and reloaded at a later time. See Saving and loading projects.

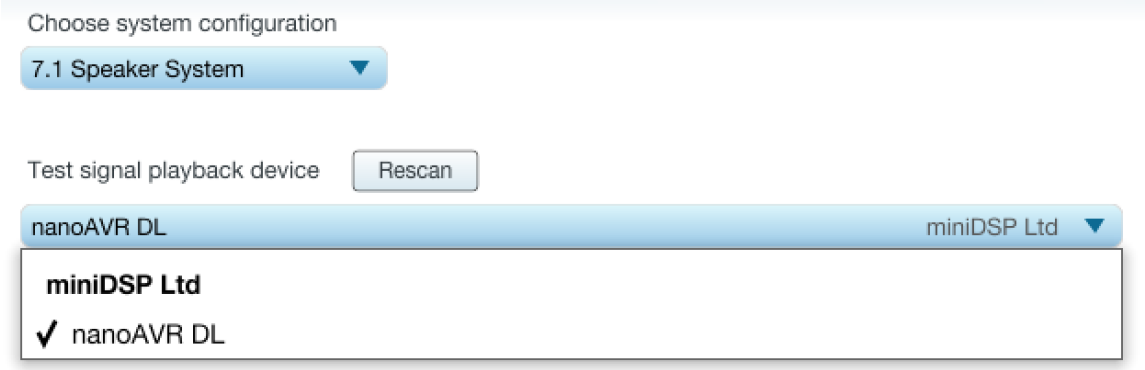
Back to previous / proceed to next

Use these two buttons to advance to the next tab when each is complete, or to go back to the previous tab to make alterations. The tabs at the left can also be clicked on directly.

Help open/close

Click on the small Help divider at the right of the screen to open a pane with help on the currently selected tab. Click on the divider again to close the help pane.

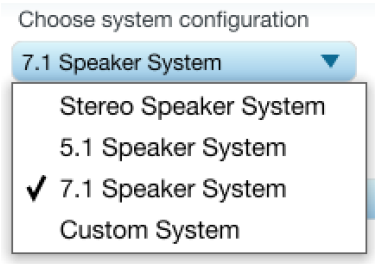
3.4.1 Sound System tab



On the **Sound System** tab, set the following parameters.

Choose system configuration

Use the dropdown menu to select the system configuration. For home theater use, usually **5.1 Speaker System** or **7.1 Speaker System** will be selected. However, you should choose **Custom System** for a different number of channels, a different channel assignment, or to disable LFE gain alignment (see Custom System configuration below for more information).



This setting should be based on the number of HDMI Audio channels passing through the nanoAVR DL, not the number of speakers being driven by the AVR. To ensure that 7.1 content will be processed by Dirac Live, select **7.1 Speaker System**.

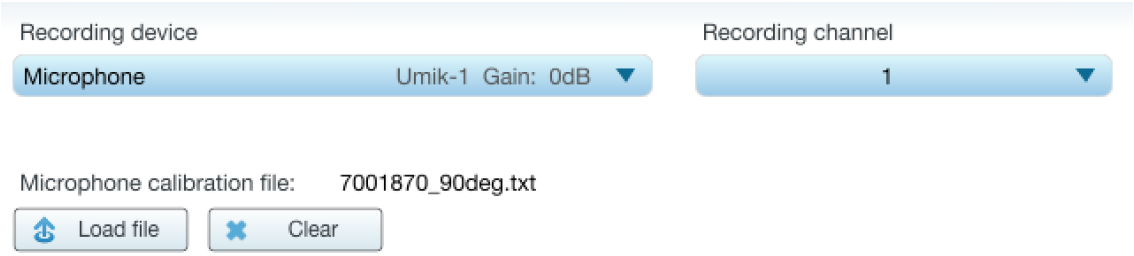
Test signal playback device

Preset to **nanoAVR DL**. This will ensure that test signals are sent into your audio system via the nanoAVR DL processor.

If the entry for **nanoAVR DL** is not showing, check that your nanoAVR DL processor is connected via USB and powered on, click the **Rescan** button, and then use the drop-down menu to select **nanoAVR DL**.

Once you have verified that this tab is correct, click the **Proceed** button.

3.4.2 Mic Config tab



On the **Mic Config** tab, set the following parameters.

Recording device

Preset to the **UMIK-1**.

If UMIK-1 is not showing, ensure that the UMIK-1 is connected securely to the computer via USB, then go back to the **Sound System** tab and click on **Rescan**. Then use the drop-down menu to select the "Microphone" item underneath "UMIK-1".)

Recording channel

Select **1** from the drop-down menu.

Microphone calibration file

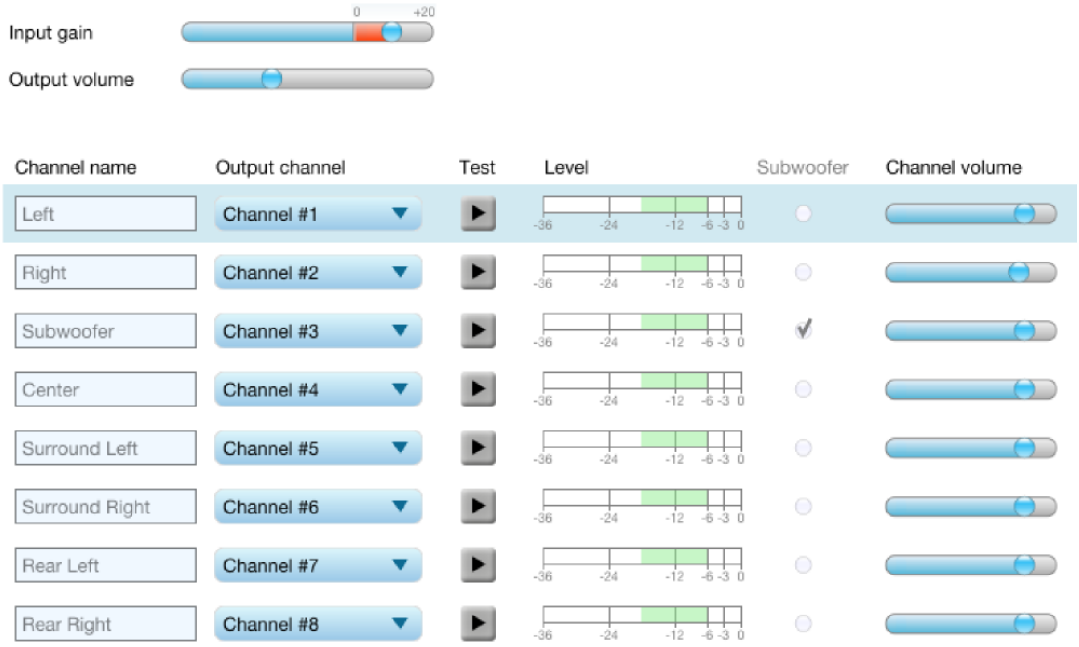
Each UMIK-1 measurement microphone is individually calibrated to ensure accuracy. To download the unique calibration file for your microphone, go to the UMIK-1 page and enter your microphone's serial number. It is in the form xxx-yyyy and labelled on the microphone. Ensure that you download both the regular calibration file and the "90-degree" calibration file. (The latter is generated specifically for use with miniDSP's multi-channel Dirac Live® processors such as the *nanoAVR DL*, *nanoAVR DLA*, and *DDRC-88A*.)

Then click on the **Load file** button and select your calibration file.

For home theater applications, it is best to use the 90-degree calibration file as this is created specifically for the vertical microphone orientation. This file is downloaded with the suffix "_90deg" in the file name.

Once you have verified that this tab is correct, click the **Proceed** button.

3.4.3 Output & Levels tab



The **Output & Levels** tab is used to set the signal levels used in the subsequent measurement:

1. Set **Output volume** quite low. If you have another volume control "down-stream" of the nanoAVR DL, set it about halfway (or around -20 dB) and increase it later if needed.
2. Connect an HDMI source to the currently selected HDMI input. (This is needed so that audio can be transmitted over the HDMI output.)
3. Click on the **Test** button for the left channel and gradually increase the output volume until it is at a moderate level, such that your voice would have to be raised to converse with someone sitting next to you .
4. Increase the **Input gain** slider until the blue bar on the level meter reaches up into the green section:

5. Click again on the **Test** button for the left channel to stop the test signal.
6. Click on the **Test** button for each of the remaining channels. If any channel is not in the green zone, use its **Channel volume** slider to adjust the volume of the test signal for that channel. (Some re adjustment of **Input gain** and **Output volume** to get all channels "green" may also be required.)

The nanoAVR DL requires an active video signal input in order to output audio data. This is because HDMI inserts the audio data between the video frames. If you do not hear audio when pressing a **Test** button, ensure that an HDMI video source is connected, selected, and not asleep.

When done, click the **Proceed** button.

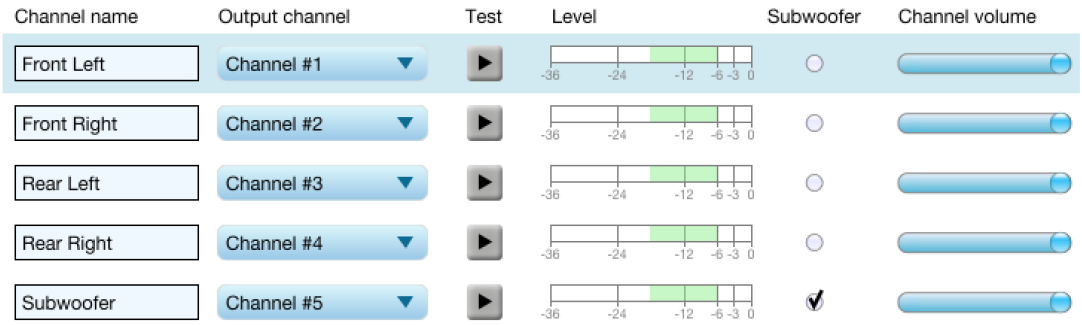
3.4.4 Custom System configuration

On the **Sound System** tab, choose the **Custom System** configuration if any of the following apply:

- Your system does not fit any of the three predefined configurations (Stereo, 5.1, 7.1).
- You want to use a different channel mapping than the default.
- You do not want the nanoAVR DL to calibrate for a 10 dB LFE alignment gain on the subwoofer channel. (LFE alignment gain is used to compensate for the reduced level of the LFE track as it is recorded to movie soundtracks. For almost all home theater applications, **5.1** or **7.1** is the correct choice. Custom configuration should be used only in special circumstances.)

After choosing **Custom System**, you will need to select the number of channels that you want to use.

When you get to the **Output & Levels** tab, it will show controls for the number of channels that you selected:



Channel name

Type any name you like for each channel.

Output channel

By default, each input channel maps to the same numbered output channel (input channel 1 to output channel 1, and so on). The dropdown selectors can be used to change this mapping. Note that DLCT will not let you assign more than one output channel to each input channel.

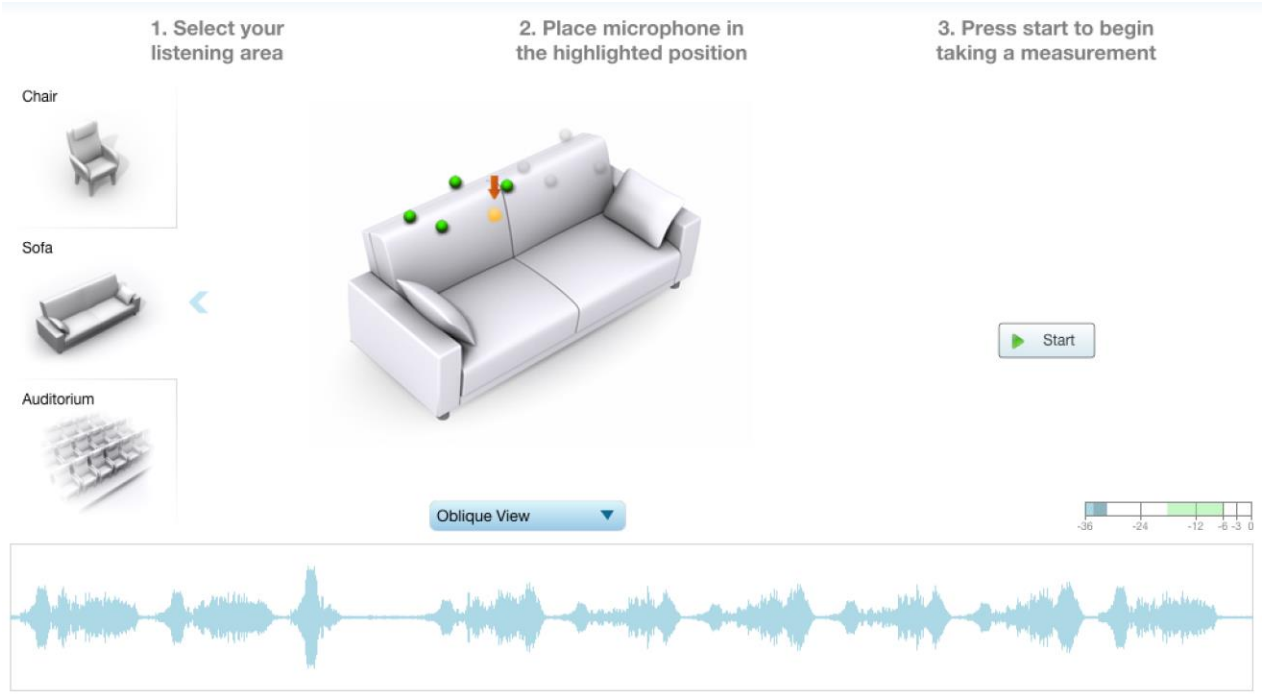
If your custom system configuration has less than eight channels, inputs are assigned in sequential order. For example, for a 4.1 channel system, channels 1 through 5 are used.

Subwoofer

The subwoofer checkbox tells the Dirac Live analysis algorithm to use a different method to detect the impulse on that channel, which in turn affects the delay that will be assigned to that channel. This is needed because of the limited frequency response of the subwoofer.

3.5 RUNNING THE MEASUREMENTS

Acoustic measurements are performed on the **Measurements** tab.

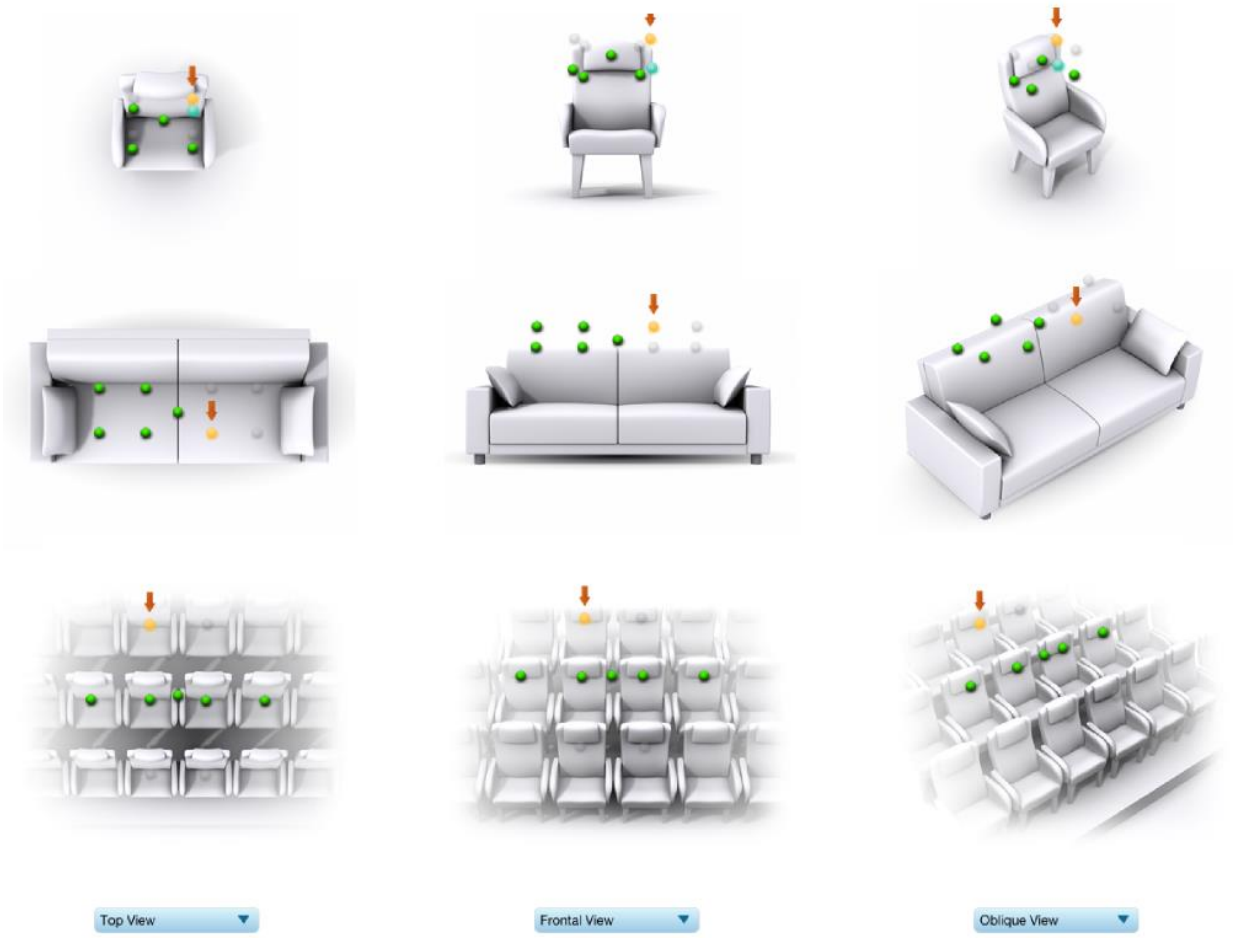


Measurements should be performed under good conditions. While the measurement technique used by Dirac Live is quite robust, low-frequency noise (traffic, machinery, aircraft, storms) in particular can adversely affect measurement accuracy. A high level of ambient noise can also prevent the algorithm from analyzing the test sweep signal properly. Minimize the effect of any external noise and/or choose a suitable time for performing measurements.

3.5.1 Listening environment

The **Measurements** tab presents three different listening environments as a visual guide to positioning the microphone for each of the nine measurements: **Chair**, for a single listening seat; **Sofa**, for multiple listening seats; and **Auditorium**, for a dedicated home theater or larger venue with staggered seating. Use the icons at the left of the screen to select the listening environment.

The center of the screen contains a pictorial representation of the selected listening environment, with dots marking the recommended microphone locations. Completed measurements are shown in green, while the next measurement to be done is highlighted in yellow and has a red arrow marker pointing to it. A drop-down menu underneath selects three different views, which should be used to help you place the microphone in a suitable location.



While the visual guide indicates a suitable set of microphone locations, these locations can be varied to suit individual circumstances. It is, however, imperative that the first measurement is taken in the **center** of the listening area, as this measurement is used to set the levels and delays of each channel. The subsequent eight measurements should be well spread out over the entire listening area so that Dirac Live can acquire a good set of measurements that capture the acoustic behavior of the room. Placing all microphone locations too close to each other may result in "over-correction" that will sound dry and dull.

For example, if using the **Chair** listening environment, spread the microphone positions over a circle with a diameter of a meter (three feet). Vary the height of the microphone up and down by 30 cm (one foot) from the initial position. If using the **Sofa** or **Auditorium** listening environment, again spread the measurement locations over the full listening area and vary microphone height by a significant amount.

A different set of locations other than those indicated by the visual guide and the above guidelines can be used if necessary. The important thing is to ensure that the measurement locations are spread out over the whole listening area and that the microphone is moved a sufficient distance vertically as well as horizontally.

In some cases, such as when the listening area is very close to the loudspeakers or the loudspeakers have a very narrow dispersion pattern, the size and in particular the height of the measurement area can be reduced, to avoid discrepancies caused by varying output response from the speakers themselves.

3.5.2 Executing a measurement

With the microphone in place at the central location and pointed vertically (that is, towards the ceiling or floor), click on the **Start** button. The nanoAVR DL HDMI audio processor will generate a test signal, audible as a frequency sweep through the left front speaker, then the right, and so on through all channels including the subwoofer. Finally, the frequency sweep plays through the left front speaker again.

While the measurement proceeds, the time-domain response graph of the captured audio signal is displayed at the bottom of the measurement tab. (This graph is related to the magnitude response but is not the same display. Its purpose is to verify that the recorded signal level is in a suitable range.)

After completion of the measurement sweeps, the status bar will update with a progress indicator as the program performs calculations on the measurement signal. If the measurement was successfully captured, the red arrow marker will advance to the next location to be measured.

If the program indicates that the measurement was not successful, you will need to take corrective action. The most common errors are related to signal level:

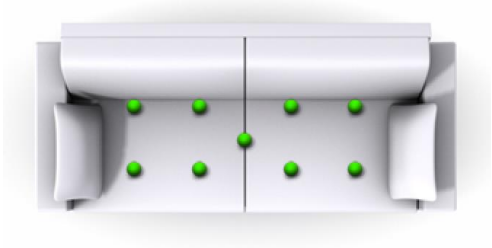
- The measurement signal is too low to ensure a clean capture.
- The measurement signal is too high and the audio signal has exceeded the maximum level (clipping). This is shown in red on the signal graph.

In either of the above cases, go back to the **Output & Levels** tab and adjust **Output volume**, **Input gain**, or the **Channel volume** slider for the channel that caused the problem. Then re-run the measurement. (You do not need to redo the measurements you have already successfully completed.)

3.5.3 Completing the measurements

After each successful measurement, the location marker (red arrow) will advance to the next location. Move the microphone to that location, using the three views (top, front, oblique) as a guide to positioning it. Then click on **Start** again. Repeat this process until all nine locations have been successfully measured.

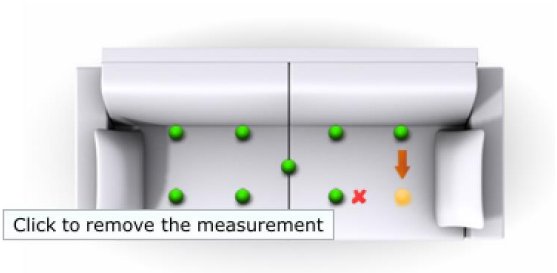
Note: it is good practice to save the project periodically while performing measurements (see Saving and loading projects below).



3.5.4 Viewing and redoing measurements

Click on the green dot for any completed measurement to display its measured time-domain response graph.

After clicking on a green dot, a small red "X" will appear next it. Click on the "X" to delete the measurement. The status bar will indicate that the program is recalculating parameters.



To redo a measurement, delete it, move the microphone to the appropriate location, and click on **Start**. Note: if more than one measurement is deleted, the marker will move to the lowest-numbered one.

It is important that all nine measurements are completed in order to ensure best results from the optimization algorithm. Being patient and thorough will pay audible dividends!

Once all nine measurements have been successfully completed, click the **Proceed** button.

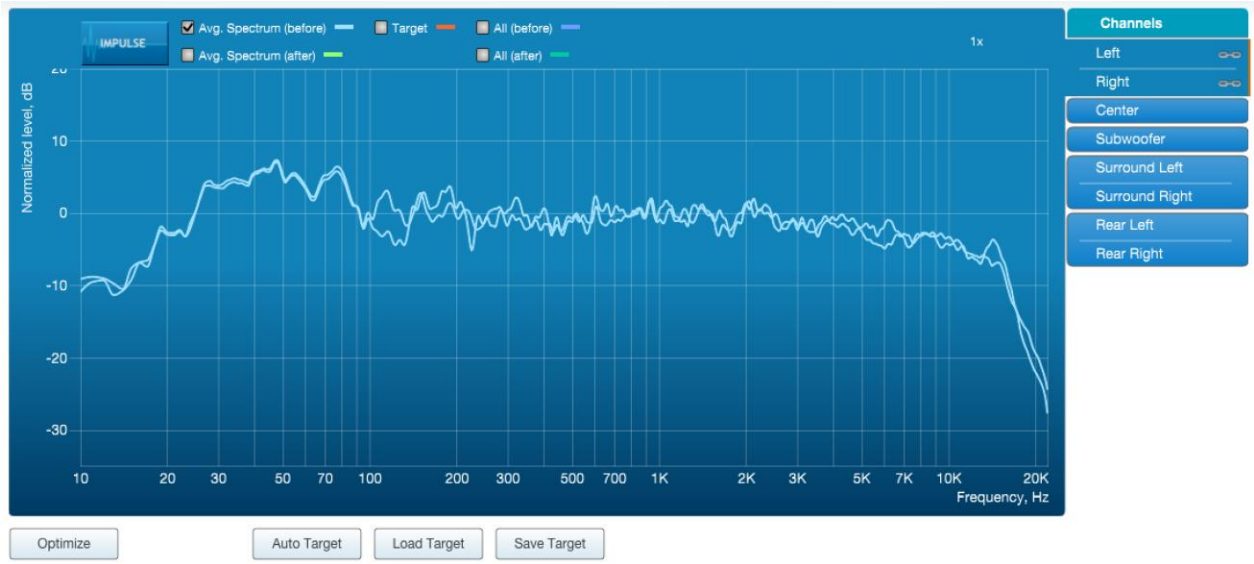
3.6 SAVING AND LOADING PROJECTS

Each set of measurements and the associated configuration settings are called a *project*. The project should be saved at regular intervals by clicking on the **Save** button. The default location for project files is **C:\Users\[User]\Documents\MiniDSP\nanoAVR\Projects**, but you can store them in any location in your file system.

A project can be reloaded at any time by clicking on the **Load** button. This enables you to generate new correction filters for different target curves at a later date, or to redo any of the measurements. (Note: if you wish to change between the **Chair, Sofa**, or **Auditorium** listening environments, you will need to start a new project.)

4 FILTER DESIGN

T he **Filter Design** tab shows sets of graphs for the various channels. Click on the tabs at the right to display the response graphs for different sets of channels (left and right, center, subwoofer, and surrounds, in the case of 5.1 and 7.1 systems). For each set of graphs, a number of variants can individually be turned on and off with the checkboxes above the graphs.



Avg. spectrum (before)

The average of the measured magnitude responses. These plots are shown in light blue.

Avg. spectrum (after)

The predicted average magnitude response after correction. These plots are shown in green, and can be viewed only after filters have been generated with the **Optimize** button.

Target

The target curve – that is, the desired in-room magnitude response. This curve is user-adjustable so you can fine-tune it to best suit your speakers, room, and preferences. See Designing your target curve below.

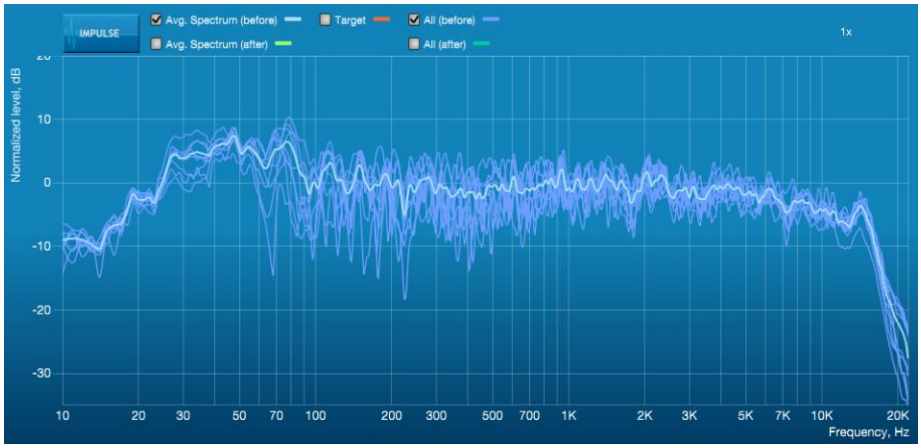
All (before)

All of the measured magnitude responses. These plots are shown dark blue.

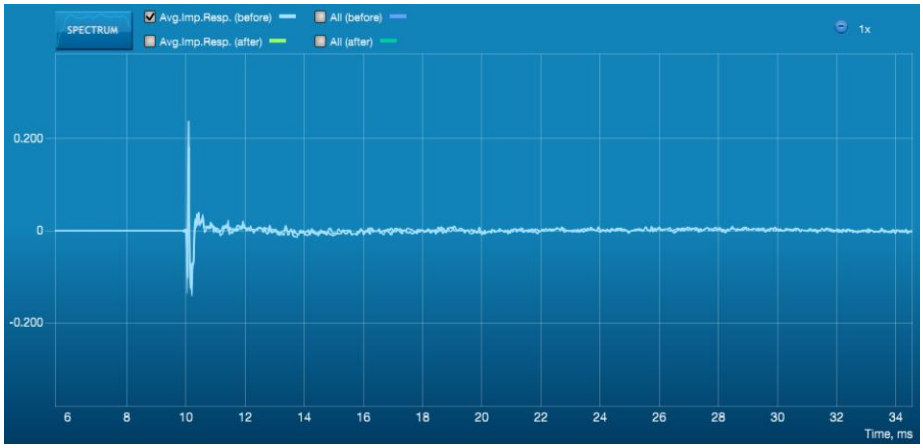
All (after)

All of the predicted magnitude responses after correction. These plots are shown in dark green, and can be viewed only after filters have been generated with the **Optimize** button.

The graphs showing all nine measurements are useful for seeing how much variation there is across the listening area:



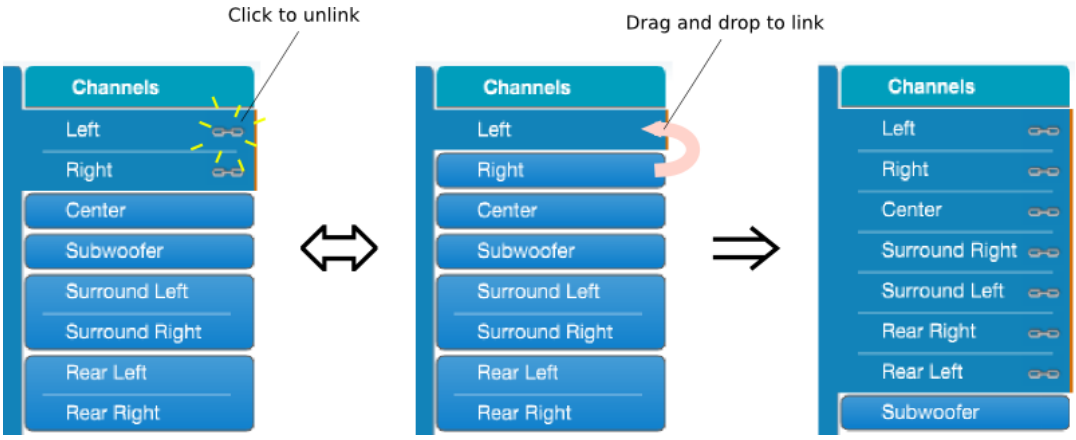
To display the impulse response instead of the magnitude response, click on the **Impulse** button at the top left of the display. All nine individual impulse responses can be shown as well as the average response. The predicted impulse responses after correction can be viewed after filters are generated with the **Optimize** button (see Generating correction filters below).



To return to the magnitude response, click on the **Spectrum** button.

4.1 LINKING AND UNLINKING CHANNELS

Channels can be linked together, as indicated by the small "chain" icons on the tabs at the right of the graph. When channels are linked, their graphs display together, and they share the same target curve and range of frequency correction. By default, the front left and right, surround left and right, and rear left and right channels are linked.



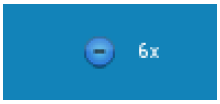
To unlink a channel, click on its chain icon. It will then be unlinked from the other channels. To link it to another channel or groups of channels, drag its tab on top of the channel or group of channels that you want it linked to.

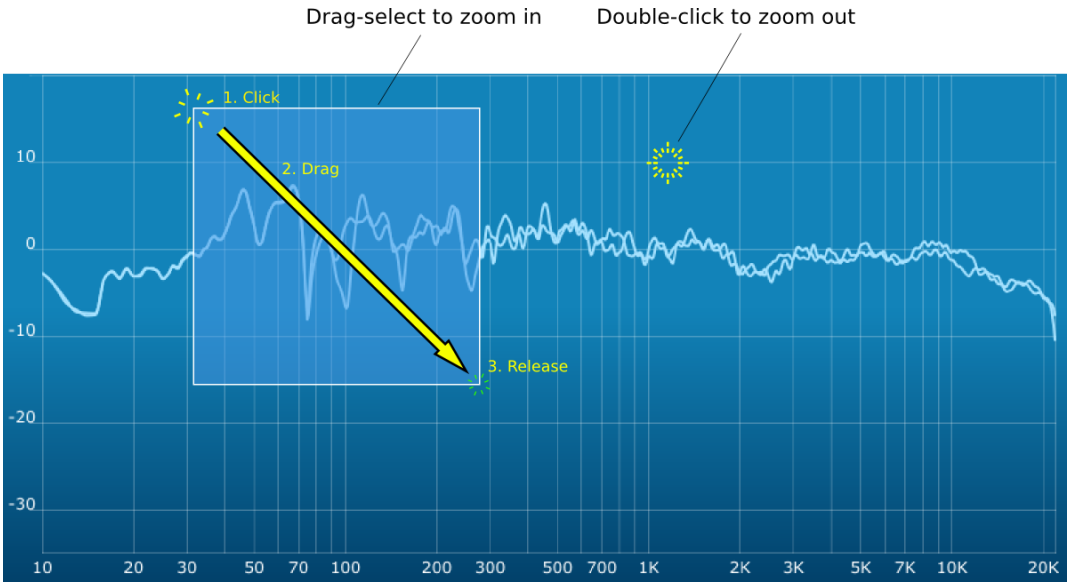
Initially, you may wish to link all speaker channels together, as shown at right in the diagram above, as this will make it easier to experiment with target curves. Once you are up and running, you can then experiment with different target curves for groups as shown in the center above.

4.2 ZOOMING IN AND OUT

The response graphs can be viewed at a larger scale. To zoom in and out:

- Drag-select a region of the graph to zoom in on it. (Click the left button, move the mouse while holding the button, release the button.) You can then drag-select a region again to zoom in further.
- Double-click on the graph to zoom back out to the previous zoom level, or click on the small "–" sign next to the zoom indicator at the top right of the display.





4.3 DESIGNING YOUR TARGET CURVE

The *target curve* is the desired in-room frequency response with the nanoAVR DL processor performing digital room correction.

4.3.1 The Auto Target

When first viewing the **Filter Design** tab, an estimated target curve suitable for your speakers is shown as the red curve. This calculated target curve can be restored at any time by clicking on the **Auto Target** button.

Note: restoring the auto target will erase the current target curve. If you wish to keep it, you can save it to a file – see Saving and loading target curves below

4.3.2 Editing the target curve

You can edit the target curve to produce any desired magnitude response. This is done with the use of *anchor points*, shown as orange dots on the curve:

- Drag an anchor point to move it.
- Double-click on the target curve to add an anchor point.
- Double-click on an anchor point to delete it.

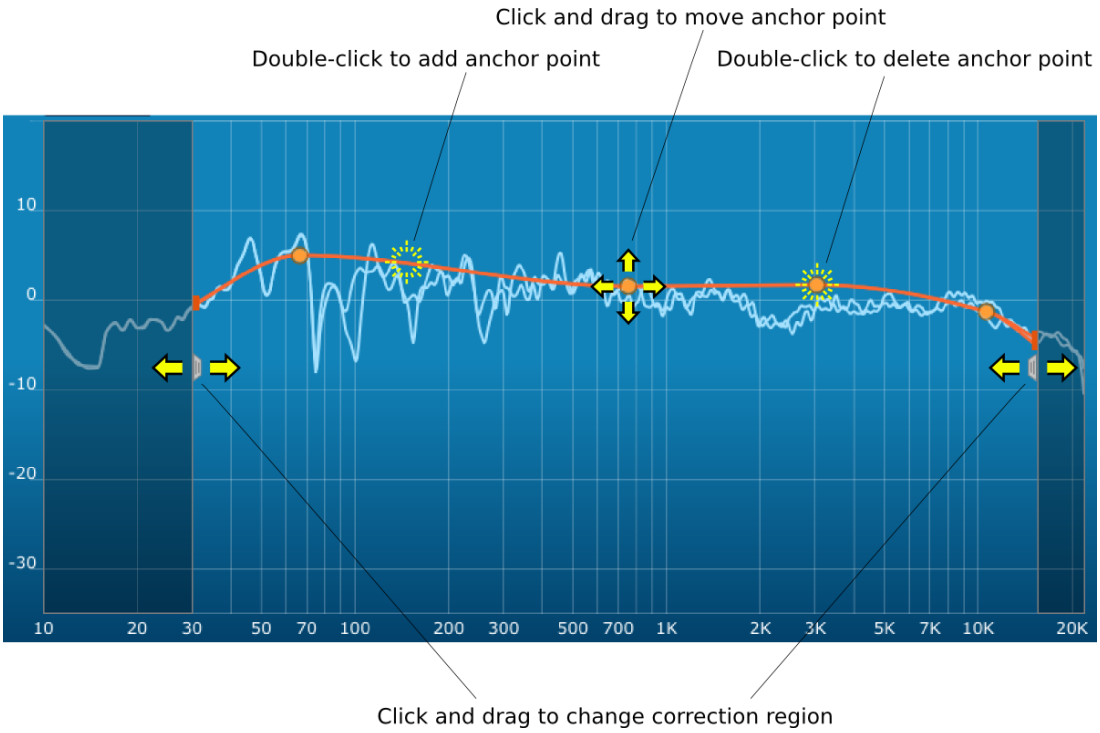
If channels are linked, the same target curve is used for that group of linked channels. To create a separate target curve for a single channel, unlink it as described above in Linking and unlinking channels.

4.3.3 Changing the frequency range for correction

The regions to the left and right of the response graphs that are shaded in a darker color are excluded from magnitude response correction. Dirac Live chooses a suitable range by default, but you can adjust this range for your system and preferences. For example, low-frequency noise (traffic, machinery) may be present in some environments, so it is best to adjust the frequency range to exclude these frequencies from the correction. Or,

you may be happy with the in-room response at higher frequencies, so you can set the frequency region to limit correction to the modal region (up to 300 Hz, in a typical room).

To alter the region of correction, drag the grey handles on either side of the graph. Note that you can't drag these handles over an anchor point, so you may need to move or delete an anchor point that is "in the way."



4.3.4 Guidelines for target curve design

Care should be taken to create a target curve that works well with your speakers and room, as well as suiting your personal preferences. Small changes to the target curve can have significant effects on the tonal quality of the system, so it is important that you experiment with different target curves to find the optimum.

If you initially don't achieve a satisfactory result, please ensure that you have spread your measurements over a sufficiently large area and with sufficient variation in height. The following guidelines will help you understand how to adjust your target curve.

Low-frequency extension and boost

All loudspeakers have a natural low-frequency roll off. Setting the target curve to boost the region below the speaker's natural roll off frequency *may* result in overdriving the speakers, especially with smaller loudspeakers and depending on your listening habits. As a general rule, a home theater system should use bass management to direct low frequency content to the subwoofer.

The auto-target estimates the low-frequency roll-off and curve. You should determine by listening whether this estimate is suitable for your system, and adjust the target curve accordingly.

High-frequency "tilt"

The target curve is the desired measured response of loudspeakers *in a room,* In contrast to measurements made of a loudspeaker during its design under anechoic (measured in free space) conditions. While high-quality loudspeakers are usually designed for a flat on-axis anechoic response, these same speakers when placed into a listening room will tend to have a downward-sloping or "tilting" response at high frequencies, due to the effects of limited dispersion at high frequencies and greater acoustic absorption.

A completely flat in-room response is therefore usually not desirable and will tend to sound thin or bright. Start with a target curve that follows the natural behavior of your speakers in your room, and then experiment with greater or lesser degrees of tilt in the treble region to obtain the most natural timbral balance.

Low-frequency adjustment

A completely flat response at low frequencies, with complete elimination of peaks due to room modes, may sound light in the bass. Often, a slight increase in the target curve below 100 Hz will give a more balanced sound, yet without introducing audible irregularities in bass response.

Magnitude response dips

In some cases, it may be helpful to adjust the target curve to follow dips in the magnitude response. This can occur where, for example, the listening area is very close to the speakers and the measurements exhibit a dip caused by the vertical response of the speakers themselves. In such a case, you can adjust the magnitude response to follow the dip. (You may also wish to try a different set of measurement locations.)

Unlinking channels

Usually, the corresponding left and right channels (front left and right, surround left and right, and rear left and right) should remain linked for target curve adjustment, to ensure that both sides produce the same response across the listening area. In certain unusual circumstances, such as where the magnitude response dip discussed in the previous point shows up on only one side, you can try unlinking channels and making separate adjustments.

4.3.5 Saving and loading target curves

To allow you to experiment with different target curves, you can save a target curve to a file and reload it at a later time. Click on the **Save Target** button to save the target curve of the currently displayed channel or group of channels.

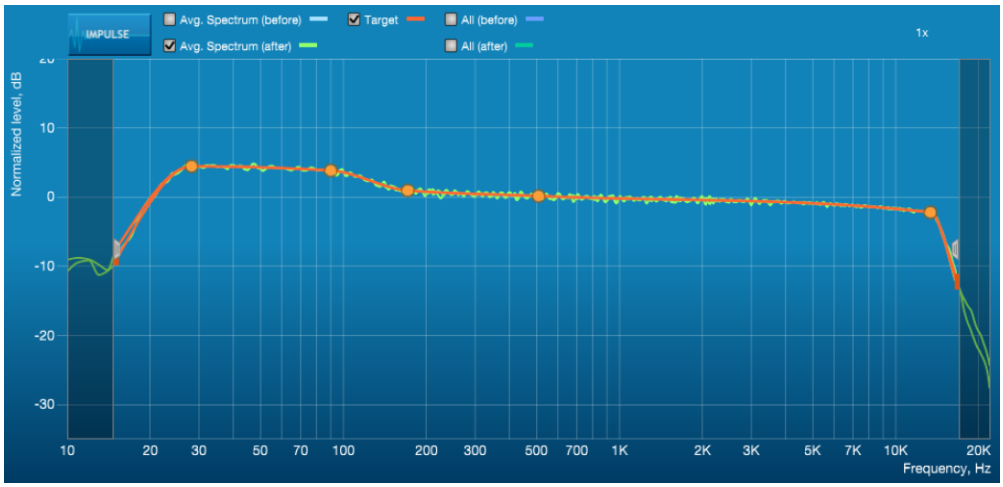
The default location for target files is **C:\Users\[User]\AppData\Roaming\Dirac\OEM\MiniDSP\nanoAVR\Targets**, but you can store them in any location in your file system.

To load a target curve, click on **Load Target**. The currently displayed channel or group of channels will have its target curve updated. (Loading a target will erase the current target curve, so be sure to save it first if needed.)

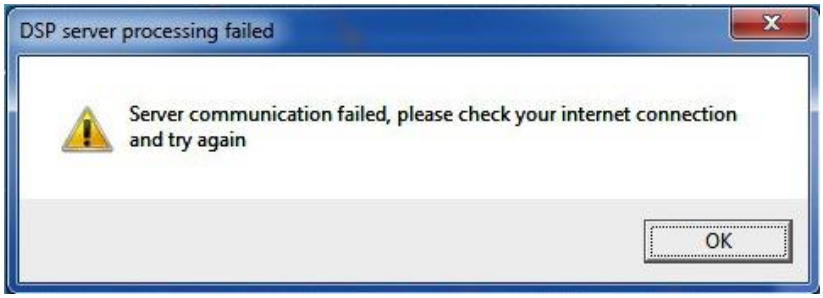
4.4 GENERATING CORRECTION FILTERS

Once you have a target curve set to your satisfaction, click on the **Optimize** button.

The status bar will update as the algorithm progresses. The entire algorithm may take some time to complete, depending on the speed of your computer. When the algorithm completes, the predicted average magnitude response will be shown in green. (The predicted impulse response can be viewed by clicking on the **Impulse** button.)



The **Dirac Live Calibration Tool For miniDSP** will contact the Dirac license server to verify its license, so you will need to be connected to the Internet to perform this step. If a firewall is in place, it must allow HTTP (normal web traffic) to pass. Otherwise, an error such as the following may appear:

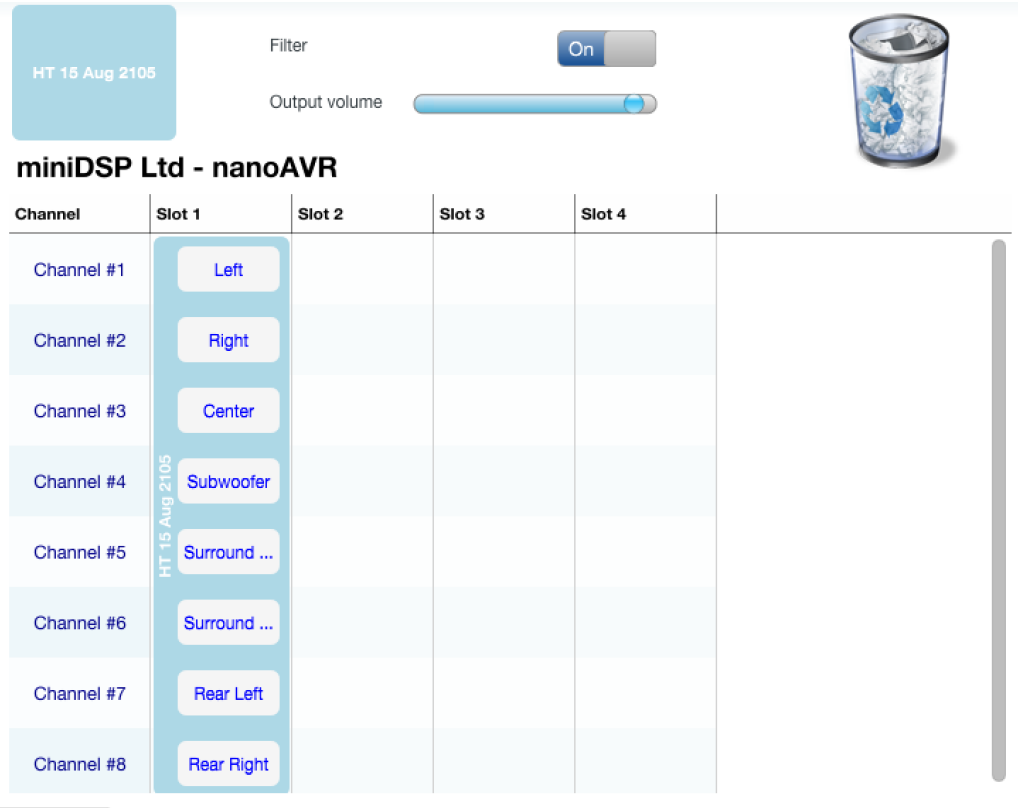


Once the filters are generated, click the **Proceed** button.

4.5 DOWNLOADING AND MANAGING FILTER SETS

The **Export** tab initially shows four empty "slots" for filter sets (a filter set is one filter for every channel). Filter sets are managed with a "drag and drop" metaphor:

- To load the most recently generated filter set into the processor, drag the box at the top left (labeled "HT 15 Aug 2105" in the example) and drop it onto an empty slot.
- To remove a filter set, click on its name (oriented vertically), drag it from the slot and drop it on the trashcan icon at the top right.
- To load a filter set into a slot that already has filters loaded, first delete the loaded filter set by dragging it onto the trashcan icon. Then drag and drop the current filter set onto the now-empty slot.



The two main controls here are:

Filter

Turn this on to enable the Dirac Live® correction filters.

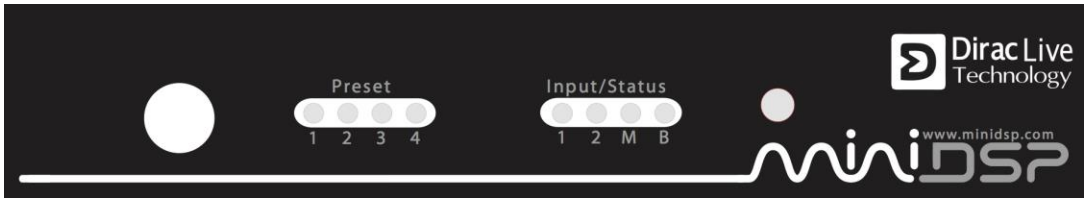
Output volume

Move the slider to adjust the output volume of the processor. Once the computer is disconnected, output volume can also be adjusted by an infrared remote control or the miniDSP smartphone app.

5 USING THE NANOAVR DL PROCESSOR

Once the desired correction filters have been downloaded into the nanoAVR DL processor, the computer is not required and can be disconnected. The front panel, an infrared remote, or the miniDSP smartphone app can be used to control:

- Filter set selection
- HDMI input selection
- Master volume (remote control and smartphone app only)
- Master mute (remote control and smartphone app only)
- Dirac Live® filtering on/off (remote control and smartphone app only)



5.1 STATUS INDICATORS

The current status of the nanoAVR DL is indicated by a set of LEDs:

Preset Indicates the currently selected filter set (1 through 4).

Input Indicates the currently selected HDMI input (1 or 2).

M Master mute is enabled.

B Dirac Live® filtering is enabled.

5.2 FRONT PANEL CONTROLS

The nanoAVR uses a minimalist physical control design with a single control button.

To change the selected filter set

Briefly press the control button. The selection LED blinks quickly. Briefly press the button to move to the next filter set, and repeat until the desired LED is lit. Press and hold the control button, and the LED will now remain steady.

To change the selected input

Press and hold the control button. The LED indicating the selected HDMI input will switch to the other input. Release the button.

5.3 INFRARED REMOTE CONTROL

Many standard and programmable remote control units can be used with the nanoAVR DL processor. Instead of adding another remote to your collection, the processor can "learn" the control codes of your current infrared (IR) remote if it supports one of the following remote control codes:

- NEC
- Sony
- Philips RC6
- Apple Remote

Learning is done with the **nanoAVR DL Utility** program. After starting the program, click on the **Connect** button. To initiate learning, simply click on one of the function buttons in the **IR Learning** box (**Master Mute**, **Volume Up**, and so on). Then point your remote at the processor and click on the button that you want to use for that function. A dialog will appear to show that the code was recognized. (If the processor does not recognize the remote control code, then it will time out and display a message saying that IR learning failed.)

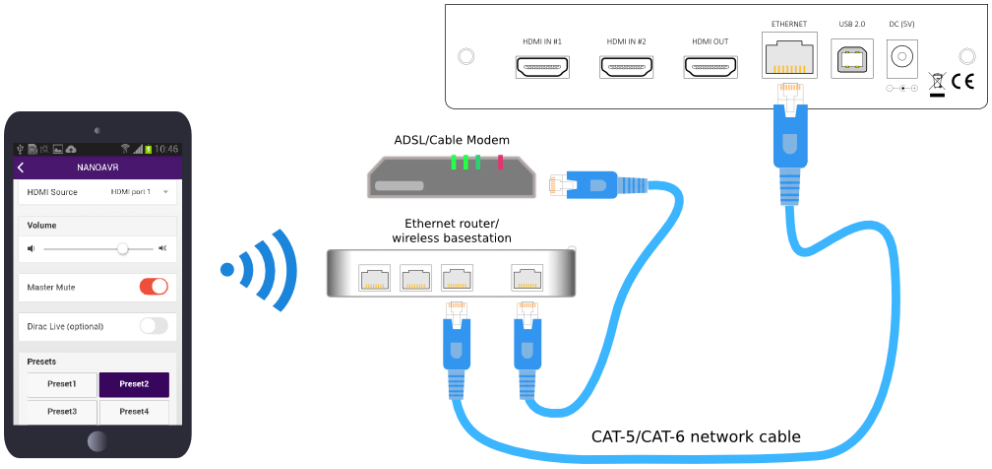
The commands **Config Inc** and **Config Dec** can be used to change the selected configuration preset up or down. This can be used instead of **Config 1**, **Config 2** and so on, to reduce the number of buttons required.

Once programmed, check that the programmed buttons perform the expected function. (Note that changing the filter set with the remote will cause the **nanoAVR DL Utility** program to disconnect.)

5.4 SMARTPHONE CONTROL APP

The nanoAVR DL can be controlled with the miniDSP control app for Android and iOS (Apple) smartphones and tablets.

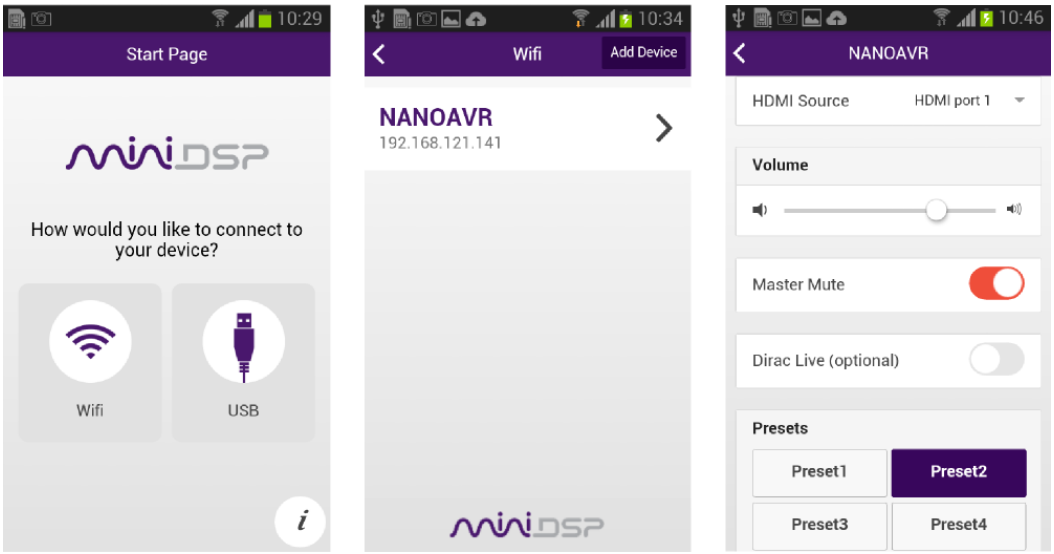
To control the nanoAVR DL over the network, connect an Ethernet cable from the nanoAVR DL's Ethernet port to a free port on your Ethernet router or switch. The diagram below illustrates a typical case . The network must be capable of DHCP so that the nanoAVR DL will be given an IP (network) address.



Download and install the miniDSP control app for your phone or tablet:

- Android - https://play.google.com/store/apps/details?id=com.minidsp.minidsp
- iOS – https://itunes.apple.com/us/app/minidsp-control-app/id945240204?ls=1&mt=8

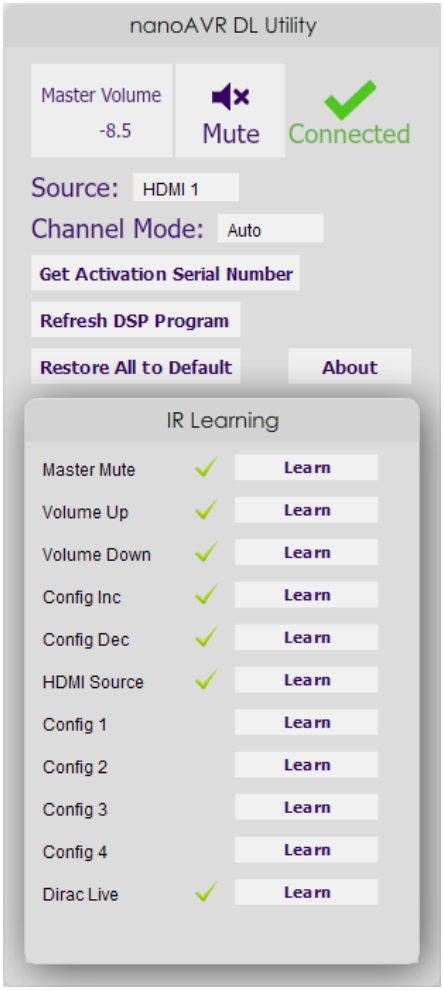
Select Wifi and then your nanoAVR DL. From here, the screen allows you to select the HDMI input, control volume, turn mute and Dirac Live on and off, and to select from the four presets.



6 Additional Information

6.1 The NanoAVR DL Utility program

The **NanoAVR DL Utility** program is an auxiliary program for configuring certain functions of the nanoAVR DL. It is not used for measurement or calibration.



Master volume

Displays the current master volume setting.

Mute

Mutes all audio output.

Connect/Connected

Click on the **Connect** icon to connect to the nanoAVR DL. To disconnect, quit from the utility program.

Source

Displays the currently selected HDMI input. Click to show a dropdown menu to select the input.

Channel Mode

Selects the way in which audio channel count is signaled to the downstream HDMI device. See Channel Mode below.

Get Activation Serial Number

Click to get the unique activation serial number for this unit. See License activation on page 12.

Refresh DSP Program

Updates the internal DSP program with the version contained in the utility program. Use this after downloading a new version of **NanoAVR DL Utility**.

Restore All to Default

Clears all four loaded filter presets.

About

Provides the current versions of DSP firmware. Please provide this information when submitting a support ticket at minidsp.desk.com.

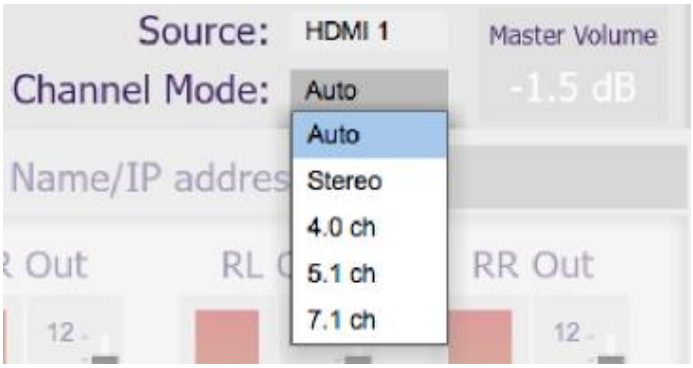
IR Learning

Buttons used to learn infrared remote control codes. See Infrared remote control.

Be sure to quit **Dirac Live Calibration Tool For miniDSP** before starting the **NanoAVR DL Utility** program. Running both programs at the same time may result in communication conflicts and odd behavior.

6.2 CHANNEL MODE

The HDMI protocol includes information specifying the number of audio channels in the HDMI stream. The number of audio channels that the nanoAVR DL signals on its HDMI output to the downstream HDMI device is selected by the **Channel Mode** dropdown selector:



Auto The number of output channels signaled is the same as received on the selected input. For example, if the selected source signals that HDMI audio is carrying a stereo signal, the nanoAVR DL passes this to its output. If the source signals that HDMI audio is carrying six channels (5.1), the nanoAVR DL passes this to its output. And so on. This is the recommended (and default) setting for the nanoAVR DL.

Stereo The nanoAVR DL always signals stereo output, regardless of the number of input channels.

4.0 The nanoAVR DL always signals four-channel output, regardless of the number of input channels.

5.1 The nanoAVR DL always signals six-channel output, regardless of the number of input channels.

7.1 The nanoAVR DL always signals eight-channel output, regardless of the number of input channels.

6.3 SPECIFICATIONS

Computer connectivity	Driverless USB 2.0 configuration and control interface for Windows and Mac OS X Ethernet control (RJ45 / 100Mbps) with ZeroConf support (autoIP/DHCP)
HDMI inputs	2 x HDMI 1.4a selectable from software, front panel or IR remote Input sample rate: 32 - 192 kHz
HDMI Outputs	1 x HDMI 1.4a output Output sample rate: 48 kHz
Audio sample rate / Resolution	Input/output resolution: 24-bit integer, 8-channel linear PCM (32-bit internal) DSP internal processing path: 48 kHz
Video support	Video pass-through of selected source (i.e. no video processing) 36-bit / 3D support / HDCP embedded keys
Storage/Presets	4 filter sets stored, selectable from front panel, IR remote, or smartphone app
Infrared remote	"Learning remote" capabilities (NEC, Philips, Sony, Apple) Controls master volume, mute, HDMI input selection, filter set selection, Dirac Live® filtering enable
Smartphone app	Controls master volume, mute, HDMI input selection, filter set selection, Dirac Live® filtering enable Supported on Android. iOS support scheduled for 2015.
Power supply	5 VDC single supply @ 600mA, 2.1 mm center-positive
Dimensions (H x W x D)	31 x 161 x 110 mm

6.4 TROUBLESHOOTING

The following table lists the most common causes of issues with the nanoAVR DL. If following this table does not provide a solution, see Obtaining Support below.

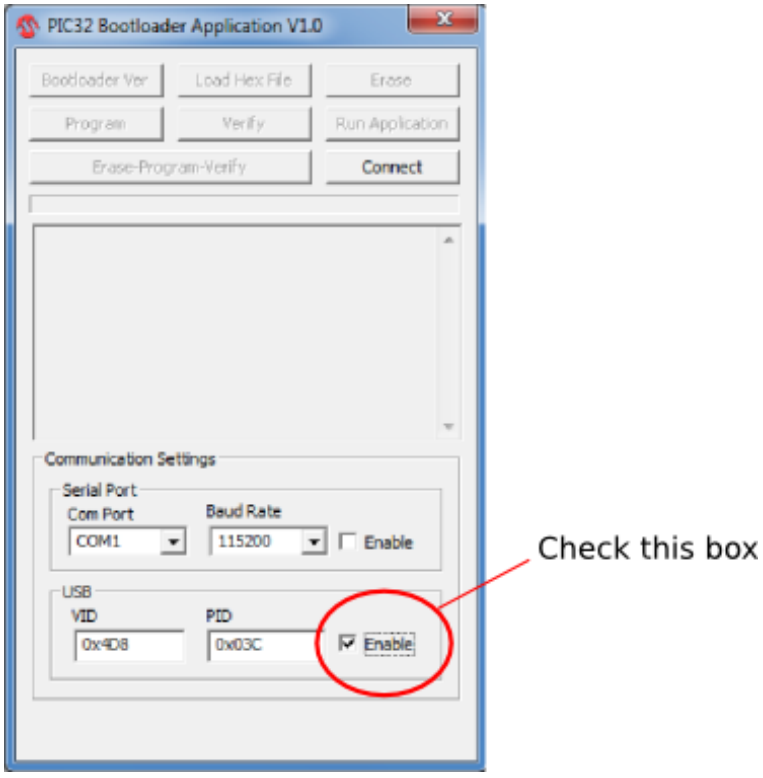
Item#	Symptoms	Troubleshooting recommendation
1	Cannot install software	a. Confirm that you downloaded and installed the required frameworks first (see Software Installation).
2	The Dirac activation screen does not recognize the serial number	a. Do not use the serial number printed on the label of the unit. You must use the serial number obtained from the firmware using the **nanoAVR DL Utility** program.
3	The license validation screen doesn't accept my username and password	a. The "username" must be the **email address** that you used when activating your license on the Dirac Live activation screen. Check that you are using the same email address and password.
4	The nanoAVR doesn't appear in the **Sound System** tab	a. Check that the USB cable to the nanoAVR DL is firmly connected. b. Check that you do not have any other program running that is attempting to communicate with the nanoAVR DL, such as the **nanoAVR DL utility** program. c. Check that you have the miniDSP version of the software installed, called **Dirac Live Calibration Tool For miniDSP**. d. Go to the **Sound System** tab and click the **Rescan** button.
5	The measurement test signal produces no output	a. Check the **Output volume** slider. b. Ensure that the nanoAVR DL processor is connected correctly into the audio system. c. Ensure that an HDMI video source is connected to the nanoAVR DL, that the source is selected, and not asleep. d. Check that the downstream device (AVR or AVP) has the nanoAVR DL processor selected for input. e. Check that any downstream volume control is not set to zero. f. Check that no downstream device is muted.
6	No input from measurement microphone	a. Check that the USB cable to the UMIK-1 is securely seated b. Check that the UMIK-1 is selected in the **Mic config** tab.
7	Insufficient recording level	a. Increase microphone level in the **Output & Levels** tab. b. Go to the Control Panel and view the Recording tab of the Sound pane. Select the UMIK-1 and view its Properties. In

		Levels, set the gain to 100. c. Increase system output volume.
8	Unable to generate correction filters (**Optimize** button)	a. Check that your computer is connected to the Internet and able to pass HTTP (web) traffic. b. Check that you do not have any other program running that is attempting to communicate with the nanoAVR DL, such as the **nanoAVR DL utility** program.
9	No audio or video while playing	a. Check that all HDMI cables are securely seated. b. Check that HDMI cables are plugged into the correct inputs and the correct outputs. c. Check that each unit (TV, AVR, nanoAVR) has the correct HDMI input selected. d. Power-cycle the complete system. Turn off all equipment and after waiting a minute, turn equipment on again in the following order: TV/display, AVR or AVP, nanoAVR DL, source/player. Leave a few seconds between powering on each unit.
10	Video but no audio	a. Check that your source/player is set to output Linear PCM over HDMI (the nanoAVR DL does not decode compressed formats such as Dolby or DTS). b. Check that the nanoAVR processor is not muted. c. Check that the nanoAVR processor master volume control is not turned down. d. Check that the downstream device (AVR or AVP) has the nanoAVR DL processor selected for input. e. Check that the downstream device (AVR or AVP) doesn't have its volume control set very low or to zero. f. Check that the downstream device (AVR or AVP) is not muted.

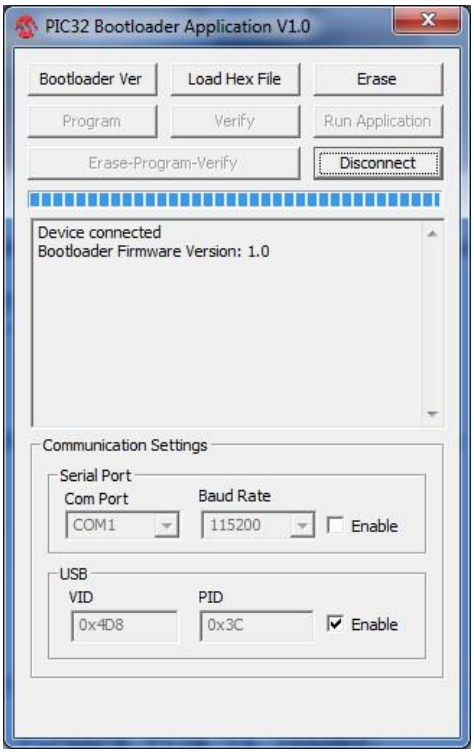
6.5 MCU FIRMWARE UPDATE

miniDSP may periodically provide an update to the nanoAVR DL MCU firmware to enable new features. To update the MCU firmware:

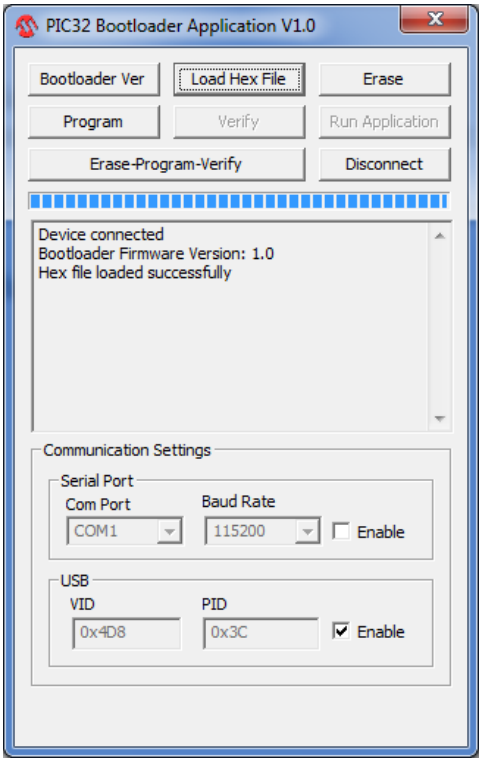
1. Download and install the latest **nanoAVR DL Utility** package from the **User Downloads** section of the miniDSP website.
2. Connect the nanoAVR DL to your computer via USB.
3. Start the **nanoAVR DL Utility** program.
4. Click on the **Connect** button. The button will display a green tick if connection is successful.
5. Click on the **Upgrade Firmware** button. The nanoAVR DL will be put into boot loader mode, indicated by just the Preset 1 LED flashing on the front panel. The PIC32 Bootloader application will automatically start.
6. Check the **Enable** checkbox in the **USB** pane near the bottom of the window.



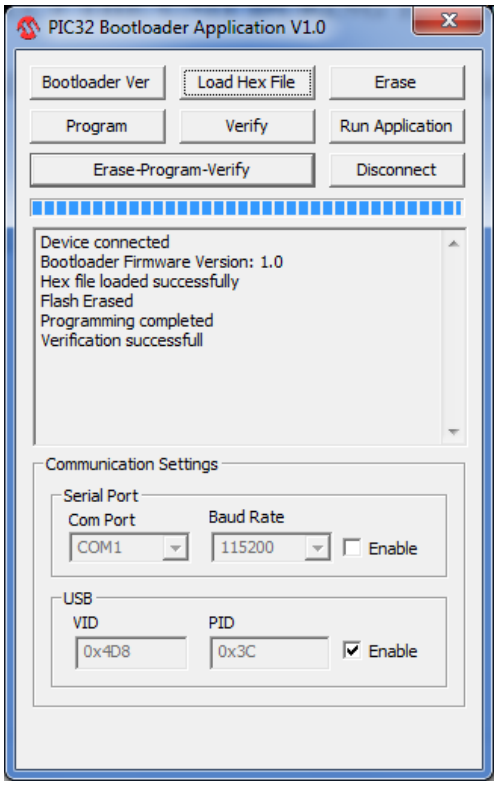
7. Click on the **Connect** button. The status display should change to show that the program has connected:



8. Click the **Load Hex File** button. Browse to the .hex firmware file located in the unzipped download folder and select it. This file will have a name like **nanoAVR_DL_v1_23.hex**. The status will show that the hex file has loaded successfully:



9. Click the **Erase-Program-Verify** button. The progress bar will update. After some time, the status will update to show successful completion.



DO NOT DISCONNECT THE USB CABLE OR POWER FROM THE NANOAVR DL WHILE THIS IS IN PROGRESS. DOING SO MAY "BRICK" YOUR NANOAVR DL.

10. Click the **Run Application** button to reboot the nanoAVR DL.
11. Click the **Disconnect** button
12. Close the **PIC32 Bootloader** application window.

6.6 Obtaining Support

1. Check the forums on miniDSP.com to see if your issue has already been raised and a solution or solutions provided.
2. Contact miniDSP via the support portal at minidsp.desk.com with:
   a. The product information obtained from **nanoAVR DL Utility** (**About** button) and **Dirac Live Calibration Tool for miniDSP** (**Sound System** tab).
   b. A clear explanation of the symptoms you are seeing.
   c. A description of the troubleshooting steps (see Troubleshooting above) you performed and the results obtained.